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PSYCHOLOGICAL TESTS AND THEIR USES

Reviews the literature from January 1935 to January 1938

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TABLE OF CONTENTS

Chapter	Page
Foreword	215
Introduction	216
I. Review and Preview	217
PERCIVAL M. SYMONDS, <i>Teachers College, Columbia University, New York, New York.</i>	
II. Intelligence Tests	221
PSYCHE CATTELL, <i>Harvard University, Cambridge, Massachusetts.</i>	
III. Tests and Studies of Infants and Young Children	229
METTA MAUND RUST, <i>Teachers College, Columbia University, New York, New York.</i>	
IV. Applications of Intelligence Testing	241
NOEL KEYS, <i>University of California, Berkeley, California.</i>	
V. Vocational Aptitude Tests	257
L. J. O'ROURKE, <i>United States Civil Service Commission, Washington, D. C.</i>	
VI. Personality and Character Measurement	269
GOODWIN WATSON, <i>Teachers College, Columbia University, New York, New York.</i>	
VII. Applications of Tests of Non-Intellectual Functions	292
CHARLES CECIL UPSHALL, <i>State Normal School, Bellingham, Washington.</i>	

Chapter	Page
VIII. Developments in Statistical Methods Related to Test Construction	307
EDWARD E. CURETON, <i>Alabama Polytechnic Institute, Auburn, Alabama,</i> and JACK W. DUNLAP, <i>University of Rochester, Rochester, New York.</i>	
Bibliography	318
Index	363

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FOREWORD

THE FIELD of psychological testing, including personality and character study, is being vigorously developed at the present time. So much material was submitted by the Committee for this issue that it had to be greatly reduced in order to keep within allowable limits. Both the text and the bibliographies were heavily cut. The Committee members should therefore receive credit for an even greater amount of work than is apparent from the material which is printed herewith. An effort was made not to eliminate any significant point in the original manuscript, or to distort the emphasis. In order to keep the issue within its present expanded size, however, rigorous economies had to be exercised.

DOUGLAS E. SCATES,
Chairman of the Editorial Board.

INTRODUCTION

TO OBTAIN ARTICLES for this issue *Psychological Abstracts* from January 1935 to December 1937 were scanned. Abstracts bearing on psychological tests were cut out, sorted according to the chapter headings agreed on by the Committee, and sent to members. Each member also combed the literature for his section. It is believed that this method has reduced to a minimum the overlapping which might ordinarily be found between chapters.

The references in the bibliography, carefully selected from many more, testify to the enormous amount of investigation which is going on in the field of psychological tests.

The organization of chapters has been altered since the June 1935 issue of the *Review* devoted to "Psychological Tests." A special chapter on tests with infants has been included. Another chapter, on the applications of tests of non-intellectual functions, appears for the first time.

PERCIVAL M. SYMONDS, *Chairman,*
Committee on Psychological Tests.

CHAPTER I

Review and Preview

PERCIVAL M. SYMONDS

THIS BRIEF CHAPTER endeavors to present a bird's-eye view of the more important trends in the work on psychological tests. The writer also ventures to make predictions of future developments and to point out what seem to be the more promising fields for research on psychological tests.

The construction of new tests of intelligence has slackened perceptibly during the past three years. A decade ago a review of a three-year period would have disclosed widespread activity in the construction of new tests of all kinds of mental functions but the present review describes only a handful. The outstanding new test is the Revised Stanford-Binet. Interview methods of estimating intelligence, and intelligence tests which may be administered orally, have been explored. Presentday test construction represents a refinement of procedures, careful standardization, and detailed statistical analysis. We are in the period of detailed quantitative and qualitative analyses of individual items on tests.

No important new trends have developed in the past three years. Much work has been done, however, in the employment of intelligence tests in a wide variety of studies seeking to discover the relationship of intelligence to every conceivable human function. Intelligence tests continue to be used for their possible value in connection with evaluating or predicting school progress. They have also received considerable study in connection with occupational status, and in the attempt to gain a better understanding of abnormal and pathological mental states.

A decade ago studies on the constancy of the I.Q. were interpreted as leading to the conclusion that the I.Q. was invariant and presumably a native function. The recent work of Newman, Holzinger, and Freeman on identical twins, the work of Wellman on nursery school children in Iowa, and the work of Skeels on children in foster homes—all reveal the possibility of marked changes in I.Q. These findings call for a rethinking of the problem of nature and nurture, which will undoubtedly receive considerable attention within the next few years.

The influence of counseling procedures in high school and college will undoubtedly be a topic for future study and discussion. There is much to be learned concerning discrepancies between intelligence and school performance. Studies to date have not revealed that there is any group of factors responsible for these discrepancies. Future work will probably proceed to the more intimate study of individual cases. The use of intelligence test results in the guidance of high-school and college students toward their future educational and vocational careers still is uncertain and more work will have to be done before established procedures are arrived at.

One gains an impression that more is known about intelligence than is being used at the present time. There is room for discussion of social action with regard to problems of eugenics, cultural influences affecting intelligence, and the adaptation of school and other social institutions toward a more effective development of intelligence.

What is said concerning intelligence tests is also true of aptitude tests. The three-year period under review has not seen the development of many new aptitude tests, but it has witnessed great activity in the study of existing tests for their value in vocational guidance and the prediction of vocational performance and success. Existing aptitude tests have been subjected to the new analytic tool of the period—factor analysis. Previously, work on aptitudes had to do largely with such general composites as mechanical aptitude, clerical aptitude, medical aptitude, and the like; and whereas interest in these more general abilities has continued, there is evidence of growing interest in more specialized abilities. In particular, the period has witnessed much activity in the study of automobile driving and the characteristics of successful aviators. There is a beginning in the development of specialized tests in such professions as law, medicine, dentistry, teaching, engineering, and nursing.

The period has also seen the beginning of attempts to study the personality characteristics which condition success in various occupations, recognizing that the problem of occupational adjustment is wider than the abilities involved. Attempts to predict teaching success through aptitude tests have been disappointing, and personality tests of the questionnaire type do not prove to be much more valuable. Along with the trend of the times, there is evidence that the study of occupational adaptation must proceed to a more individual and clinical basis before we will know exactly what factors are involved, and there are indications that this will more and more characterize research for vocational fitness and success in the future.

There has been tremendous activity in the development of new methods of personality study. The period under review might be called the heyday of the exploration of the possibilities of the questionnaire. The groundwork which was laid in the preceding fifteen years has come to its climax and it is doubtful if such interest in the questionnaire will be maintained in the years to come. A wide variety of methods and approaches has been employed, many have proved fruitless, but undoubtedly a small residue of useful methods will remain as the permanent contribution to this work. Watson, in his review of adjustment questionnaires, comments: "It is probable that reports of unhappiness are less contaminated with pretense than are reports of happiness." This statement probably applies to personality questionnaires of all kinds whether of adjustment, interest, or attitude, and indicates that questionnaires showing a high degree of unfavorable response have some value in identifying persons who need further study. There is an enormous number of articles devoted to the development and application of attitude measurement.

Not only have the conventional methods of studying personality been developed further but there has been much activity in exploring less familiar procedures. The Rorschach method must be considered now as having a recognized place in the study of personality in American psychology. A number of studies have used the matching method for the evaluation of some of the analytical and undifferentiated indexes of personality. Measures of perseveration and perception have received some exploration.

It is the writer's judgment that methods for the study of personality based on measurement have hardly fulfilled the expectation originally held for them on the basis of the success of measures of intelligence. One can note a rise in more qualitative and analytical methods of personality exploration. The Rorschach method, the various methods explored by Murray in the Harvard Psychological Clinic, the variations in the use of free association, and the use of so-called "projective technics" in the observation of children's use of play materials, drawings, dramatic activity, and the like, are all indications of the direction in which the exploration of personality is now moving. These methods depend on the insight and experience of the observer, rather than upon a blind computing of scores. It is possible that the genius of American psychology which is to quantify and systematize psychological methods may show how to make these analytical methods more objective.

The period under review is also characterized by exploration of the value and significance of personality tests. Scores of studies have used the Bernreuter and Thurstone personality schedules—indiscriminately, it is believed—particularly in view of the fact that the validity of such measures has never been definitely established. That much of this work is proceeding blindly rather than on the basis of insightful theory and promising hypotheses is testified to by the large number of studies in which little or no relationship is found.

Work with tests of social attitude is more promising. Much has been done in the applications of the Thurstone Attitude scales. The beginnings of studies on the formation of attitudes are noted, but there is room for a wide variety of experimentation on the formation and changes in social attitudes.

There has been surprisingly little research on the use of interest measures, in view of their potential value in guidance. There is much profitable work to be done in this area; technics are readily available.

The advancement of statistical technics during this period is astounding. Many will be surprised to learn that the traditional Pearsonian statistics, which have been the stock-in-trade in scores of statistics texts for the past thirty years, are due for a decided transformation. Curiously enough, the first satisfactory popular statistics textbook employing the new Fisher principles has yet to appear. The comment made by Cureton in his section, to the effect that "the more general use of modern sampling theory and exact tests of significance will require much careful expository work to make the technics more generally available and may in fact imply no

less than a total abandonment of the idea of non-mathematical elementary statistics," is significant. Does this point toward the probability that statistics is to become a technical tool to be used only by the experts, and that the dream of having all psychology and education students master elementary statistics in order to handle their test results and experimental procedures will have to be abandoned? Cureton has made such an excellent summary and recommendation of future research that it is not necessary to elaborate these ideas at this point.

The construction of a simplified test-scoring machine and the development of simplified methods of handling mass data point to the possibility of a more widespread use of psychological and educational tests. The merging of psychophysical theory and the theory of test construction points toward a better established theoretical basis for measurement procedures. Finally, one must commend the industry which has been shown in developing, refining, and applying theories of factor analysis. The writer must admit that he leans toward the interpretation given by Thomson and Tryon, that there is no guarantee that factor analyses of batteries of tests represent psychological realities. It will probably be agreed that this work is in a highly experimental state and that considerable further work is destined to be done before we are certain as to the real value of the methods.

Following is a list of the studies which have received special praise in the chapters of this *Review*: 9, 37, 43, 52, 54, 55, 114, 171, 215, 253, 301, 331, 346, 362, 440, 573, 647, 691, 778, 818, 870, 918, 919, 920, 949, 950, 958, 980. This list may be thought of as an honor roll of the studies reviewed in this issue.

CHAPTER II

Intelligence Tests¹

PSYCHE CATTELL

Individual Tests of General Intelligence

PROBABLY the most important contribution to the field of intelligence tests during the last three years is the New Revision of the Stanford-Binet by Terman and Merrill (55). Ten years of work have been put into a thorough and careful revision and restandardization. The range has been increased both upward and downward and now extends from two to twenty years. The test contains a richer sampling of abilities than the old scale. Using the ninety items of the old Stanford-Binet as a starting point, the authors developed provisional scales having 408 items which were selected from "a study of every kind of intelligence test item that has been used or suggested" or that could be devised by the authors. From these provisional scales, the authors developed two forms of the test, each containing 128 items. An unusual effort was made to secure a representative sample of the white population of the United States for the standardization. Over 3,000 subjects were used from seventeen different communities in eleven states. One hundred cases were examined at each age group between the ages of two and five and between fifteen and twenty inclusive, and two hundred cases at each of the intervening ages. In each age group an equal number of boys and girls were tested and each child tested was given all the items in the provisional forms appropriate to his mental age.

The index of reliability was found to vary with the intelligence quotient rather than with the chronological or mental age, but was high at all levels. The test is of too recent date for reports regarding its practical use in the field to have been published. The present writer has used it extensively with preschool children between the ages of three and six years and has found it markedly superior to the old form and to any other intelligence test available for these ages.

The only article concerning the New Stanford-Binet that has appeared is one by Mayer (39) dealing with negative reactions aroused by the tests in a group of 277 children between the ages of eighteen and sixty-six months. Mayer's data showed the most frequent negative responses at three years, though the amount is fairly constant between the ages of two and four and one-half years. After four and one-half years, there is a marked drop. Two of the items which required verbal responses to verbal stimuli aroused negative reactions in over 30 percent of the children, while items involving objects and manual performance aroused very little or none. It might be added that the amount of antagonism aroused in the child by any test is closely related to the skill of the examiner.

¹ Bibliography for this chapter begins on page 310.

Another recently published individual battery of tests is the Detroit Tests of Learning Aptitude (5). An examination of the test material and pupils' record booklet gives the impression of a test carefully thought out and well put together. The directions for scoring and administering are adequate and clear, but the discussion of the scale, its general use, validity, reliability, and the construction of the table of norms is disappointing. All that can be determined from the manual regarding the number of cases on which the subtests are standardized is that it is probably under fifty. The test as a whole was not standardized, the total mental age being the median of the mental ages on the subtests. Intercorrelations were obtained for sixteen of the tests. No reason is given for the omission of the other three. No table of the coefficients is given, and no reliabilities are reported except for one subtest. It is claimed that the results of this test "are very closely comparable with those of the Stanford-Binet." This statement appears to be based on the fact that forty-five retarded children in special classes obtained I.Q.'s averaging 4.6 points lower than they had on the Stanford-Binet two years previously. Worcester and Corey (68), in a review of this test, pointed out other weaknesses.

A translation of the revised and extended Bühler and Hetzer tests appeared in 1935 (9). These are treated in Chapter III.

Maizlish (37) revised Snedden's intelligence test (49) which is based on a vocabulary test given in the disguised form of a hereditary questionnaire in which the subject is asked which of his two parents possessed the greater amount of seventy-five traits, such as being meticulous, sanguine, gentle, etc. With the purpose of making the interview appear more natural and at the same time of obtaining more information regarding the subject tested, Maizlish changed the test into a likes and dislikes questionnaire. "The subject was asked to cooperate in a study which aimed to determine why we like and dislike certain people." He was asked to tell whether he liked or disliked a person characterized by the given word and then to give his reasons for his likes or dislikes. The latter part of the question was introduced mainly to determine whether or not the subject was guessing at the meaning of the words, but the reasons given by the subject for his likes and dislikes also served to throw light on his personality and attitudes. Snedden's form of the test correlated only $.16 \pm .13$ with the Kuhlmann-Anderson Intelligence Tests while the revised form yielded $.77 \pm .04$ as an individual test and $.50$ when given as a group test.

Tuckman (65) constructed an intelligence test using as material cartoons taken from the weekly magazine *The New Yorker*. Seventeen cartoons were selected, each consisting of from two to twelve parts. The cartoons were cut apart and presented in random order to the child, who was asked to arrange them in the correct sequence. The test is an interesting novelty rather than a scientifically valid measuring scale. A reliability coefficient of .93 and validity coefficient of .85 was reported; based on a group of 114 cases with an age range of twelve years, they did not indicate a satisfactory intelligence test.

Group Tests of General Intelligence

The California Tests of Mental Maturity (38, 54) consist of four batteries, one for kindergarten and first grade, and the others for Grades I to III, IV to VIII, and VIII to XIV. Each battery consists of sixteen subtests. The total time required for the administration of the tests is about ninety minutes. The first three subtests are for the purpose of discovering any children who have visual, auditory, or motor handicaps sufficiently severe to interfere with their success on the remainder of the tests. The other thirteen tests give mental ages and intelligence quotients for what the authors term a "total mental factor," a "language factor," and a "non-verbal factor." The non-verbal tests require long verbal instructions and appear to be almost as much verbal tests as the others. The first items of some of the subtests appear to be such that they would be likely to discourage a child of the lowest grades for which the battery is intended. As a whole, however, the tests appear to be excellent, and appear to have high reliabilities. For the pre-primary and primary scale, where high reliabilities are difficult to attain, the coefficients for the subtests run from .70 to .95, and for the total battery from .90 to .96.

McCall, Herring, and Loftus (34), in their comprehensive tests, covered a wider field than the usual intelligence and achievement tests. The tests consist of four batteries: (a) an intelligence test; (b) an achievement test; (c) an educational background questionnaire; and (d) a school practice questionnaire. Each test contains from 100 to 150 items and covers Grades III or IV through IX. The intelligence tests consist of 150 rows of five words or numbers each. The subject is asked to cross out the one word that does not belong with the others. The achievement tests cover a wide field of knowledge taken both from inside and outside of school. There are nineteen headings which include such captions as "enjoying life," "buying and using things," and "arts and crafts." The educational background questionnaire is a new type of test and is planned to supplement the intelligence tests as a measure of educability. It is based on the assumption that ability to learn is in part dependent on cultural factors, and it is designed to supply information about the home and the community which will assist the teacher in understanding the child's liabilities and assets. The school practice questionnaire is a test of the extent to which a school has the "characteristics of democratic activity."

The tests leave room for a number of minor improvements, but represent pioneer work and appear to have been carefully constructed and put together. The indexes of reliability are high—that reported for the intelligence test is .97, for the achievement test, .96, and for educational background, .91. The norms for the achievement and intelligence tests are based on 20,000 cases and for the educational background on 5,000. The batteries used in combination make possible the measurement of the broader aspects of intelligence and education that have often been neglected and should prove a valuable contribution to the measurement field.

The Otis Quick-Scoring Tests of Mental Ability (43) consist of three batteries. The Alpha Test ² is an entirely new test planned for Grades I to IV. The Beta Test for Grades IV to IX and the Gamma Test for High Schools and Colleges are revisions of the Otis Self-Administering Tests of Mental Ability and are similar to them in content. The Alpha Test is composed of ninety rows of four pictures each and the child is asked to mark the one that is not like the other three. Since this battery is made up of one type of item only, it is likely to prove more satisfactory when used in combination with other tests than when used alone. Two forms have been published for each of the three batteries and others are planned for the future. The only instructions are the preliminary ones and the word "stop" at the end of twenty minutes in the primary test, and at the end of thirty minutes for the other two. The tests are thus simple to give and they may be quickly scored by means of the special answer sheet and the perforated scoring key provided. The reliability coefficients of the tests are rather low. Form A and B of the Alpha Test correlate only to the extent of .86 over a grade range of four years. The norms for the Beta Test are based on adequate numbers, but those for the other two batteries, labeled tentative, appear to be very inadequate.

Stump (52, 53) is in the process of developing a group intelligence test to be presented orally. The subjectmatter is similar to that included in many group tests. A number of advantages are claimed, the most important being: avoiding of difference in score resulting from difference in speed of reading; opportunity for every subject to attempt every item; and considerable saving in expense through use of blank paper instead of printed booklets. There are two forms of the test planned to cover Grades IV to VIII. A correlation coefficient of .74 was found between this test and the Terman Group Test of Mental Ability. Mental age norms and reliability coefficients are promised for the near future.

Garth (26), in a study of riddles as an intelligence test, gave a series of eighteen riddles to 143 college students. The reliability of the riddle test was high, namely .94, but the correlation with the Army Alpha Intelligence Test was only .54 and with Trabue's Completion Test, .35.

The Cattell tests (12), published in England, consist of four series of tests of two forms each: Scale O for mental ages four to eight; Scale I for mental ages eight to eleven; Scale II for mental ages eleven to fifteen; and, Scale III for mental ages over fifteen. Scale O is administered individually, and the other scales may be given either as individual or group tests. The tests are apparently excellent. The handbook, however, gives no information regarding the validity and reliability of the scales. Scales I and II were revised in 1936 (13). Tentative norms for Scale I, based on 500 "selected average" children, are given.

² The Alpha Test has been temporarily withdrawn from the market, but is expected to be reissued shortly in the same form, but with provisions for breaking up the long concentration period required of the pupils.

Thorndike, Woodyard, and Lorge (57, 58) published four new forms of the CAVD test for the college and high-school levels. The old form and each of the new ones were given to one hundred adults between the ages of twenty and seventy. Each item included in the new form is of known difficulty "in terms of the items of the original form." The scoring has been made quicker, easier, and more objective than that of the original form.

New revisions of the Army Alpha Intelligence Tests continue to appear. A recent revision by Schrammell and Brannan (47) consisted of three forms; and one by Bregman (7), of two forms. The authors of both revisions selected from the five forms used in the army those items most appropriate for general use, eliminating or modifying items which might not be appropriate for persons not connected with the army. The norms for the revisions of Schrammell and Brannan cover ages eleven to eighteen, and Grade VI through university graduate students. They may, therefore, be expected to be higher than norms for the general population. The revisions of Bregman have been equated to the original forms used in the army. The selection of cases and the method used are not made clear in the manual. Neither of the manuals of instruction offer any evidence regarding reliability and validity.

Other group tests of general intelligence that have been recently published are Dawson's Mental Test for ages eleven and twelve (16); the Moray House Tests for ages ten and eleven (56); the Junior School Grading Test for ages seven to nine (1); the Thanet Mental Tests for age eleven (2); the Orton Intelligence Test for ages ten to fourteen (42); Gibson's Intelligence Tests for ages ten to thirteen (27); the Kelvin Measurement of Mental Ability for ages eight to fourteen (21); Smith's Test for Grade VIII (48); and the Nebraska revision of the Army Alpha (28). Either revisions or new forms of the following tests have been put on the market: Detroit Beginning First Grade Intelligence Test (20); the Henmon-Nelson Tests of Mental Ability (30); Teachers College Psychological Test (35); Thorndike's Intelligence Examination for College Entrance (59); Thurstone's Psychological Examination for College Students (60, 61, 62); and Thurstone's Psychological Examination for High School Students (63).

Two studies, one by Benton (6) and the other by Ferguson (21), indicated that strong motivations on the part of pupils did not assist them in gaining higher scores on a group intelligence test. The studies both used an experimental and a control group, both offered, among other incentives, prizes to the experimental group for improvement in their second score over their first score, and both used Otis tests. In both instances a greater gain—statistically insignificant—was found in favor of the control group.

Tests of Particular Mental Abilities

A number of special types of tests have been described or published during the last three years. Wilson and Flemming (66) studied the relationship between perception as measured by various figures, letters, lines, etc., pre-

sented in an exposure apparatus, and various tests of reading. They used twenty-five first-grade children as subjects. The correlation between the various types of reading and perception tests averaged .22.

Stuart (51), in a study of the development of reasoning ability in 1,400 children between the ages of nine and eighteen years, applied a number of tests which included perception of forms, arithmetic reasoning, a standard group intelligence test, general information, ethical judgment tests, and others (ten in all). The intercorrelations for the various tests ranged from .06 to .70 and averaged in the low fifties. The author concluded that since motor control and the ability to handle concrete data correlate highly with the various types of mental ability tests, they should not be excluded from general intelligence tests. Chronological age, however, was apparently not held constant. It is well known that these abilities correlate highly with chronological age and, since the range is nine years, it cannot be determined from the data reported how much the coefficients are influenced by age.

Jalota (32), in a study of the value of memory tests for use as tests of general intelligence, found a correlation of .49 between a memory and a group intelligence test. A test for scientific thinking with a high reliability coefficient devised by Downing (15) gave a reasonably consistent increase in score from Grades VIII to XII. The same pupils, however, showed an irregular increase from age to age, indicating that this ability was the result of learning rather than of innate intelligence. The author wrote that: "General intelligence as expressed by the I.Q. is something quite different from the ability to handle either the elements or safeguards of scientific thinking." Similarly, Edmiston (19) found that the ability to make generalizations from certain paragraphs just read could be increased by training.

Gupta (29) devised a series of tests of reasoning ability based on a well-known story. The answers of fifty-five children are given in full and discussed at length. The conclusions drawn appear to be based on subjective opinion rather than on scientific evidence. Wells and Hylan (67) modified and extended into a series some individual test items and administered them together with the Army Alpha Intelligence Test to small groups of students of superior ability. The items include, among others, ingenuity, reversed clocks, and inverted forms. The authors found that the initial score, or what is equivalent to the usual psychometric clinical test, may be reversed after a series of repetitions. In conclusion they wrote: "It cannot be too often or strongly insisted on that psychometric techniques cannot be interpreted in isolation without risk of grave error."

Oden and Mayer (40) found the ball and field or plan of search test to be unsatisfactory below the superior plan. When the directions were worded in such a way as to make no demand for thought or for planning, almost 60 percent of the responses were such that they would receive credit at the lower level.

Non-Verbal Tests of General Intelligence

A number of non-verbal and performance tests of intelligence have been described or published during the last three years. Most of them are attempts to construct tests that can be used satisfactorily with subjects of varying cultures, who speak different languages.

Leiter (33) constructed a test the administration of which requires neither verbal instructions nor pantomime. It is planned for use with subjects of all cultural and racial backgrounds and covers the age period from the pre-school child to the adult. The tests and procedures for administering them are described in detail. The standards are based on 1,400 cases and a reliability coefficient of $.91 \pm .03$ obtained by the split-half method is reported. Another non-verbal intelligence test covering a wide age range is the Chicago Non-verbal Examination by Brown and his associates (8) which is planned for ages seven through adulthood.

Penrose and Raven (44) held that tests of perception ability are the most satisfactory tests of educative ability which are uninfluenced by special training or cultural background. The authors are now working on the standardization of a finely graded series of perceptive tests, and plan to put out an intelligence test which is little affected by education or cultural background and which they believe can be used with some modification for the deaf and the blind. Hildreth and Pintner (31) published a manual with explicit directions for administering and scoring a short form of the Pintner-Paterson Tests. The scale consists of nine of the performance tests included in the longer scale.

Oliver (41) described briefly the validation and standardization of a non-verbal test planned for use among South Africans of similar cultures but speaking different dialects. The subtests included are similar to those commonly found in paper and pencil non-verbal tests. Drever and Collins (17, 18) brought out a second edition of their book on performance tests for deaf and normal children. New material has been added to the tests and additional data added to the norms. Verbal directions for "hearing" children have been added, but without revision of the norms. Arsenian (4) adopted Spearman's visual perception test to pantomime directions in order that it might be used with non-English speaking people. The reliability of the test was found to be $.88 \pm .01$. Cunningham (14) described a non-verbal test of general intelligence which is being devised for Austrian children, and Maekawa and Yendo (36) a performance test for Japanese kindergarten children. The latter has been found to have a positive but low correlation with general intelligence. Among other performance tests that have been recently described may be mentioned the Ontario School Ability Examination (3), Garth's Puzzle Box (25), the Quasha and Likert Revision of the Minnesota Paper Form Board (46), and the peg boards and simple block models by Forbes (23, 24).

Directories

Buros (10, 11) compiled two test directories, the first covering the years 1933, 1934, and 1935, and the second covering the year 1936. The first edition listed practically all educational, intelligence, and personality tests published during the previous three years. They were conveniently classified for ready reference. A publisher's directory and an alphabetical index to the tests by title and by author were also included. The 1936 issue of the directory adds a list of recently published books on measurement. Each entry is followed by excerpts from reviews of the book.

An index of periodical literature on testing by South (50), covering the years 1921 to 1936, lists 5,005 articles alphabetically by author. It will be found useful in locating articles, the authors of which are already known. For looking up references by subject it is less satisfactory. A subject index referring to the alphabetical list by number is given, but some of the headings are followed by fifty or a hundred reference numbers, most of which might have to be looked up before the desired article is found. Some headings, such as "differences," and "diagnosis," are so broad that they are of little value; before looking up the references one would like to know what kind of differences are referred to, and what is diagnosed.

CHAPTER III

Tests and Studies of Infants and Young Children¹

METTA MAUND RUST

THIS REVIEW is based on psychological measurements of children under six years of age.

General Summaries

Dewey (97) reviewed the literature on prenatal and postnatal activities through the second year of life with special emphasis on the growth process, presenting a bibliography of 216 titles. M. C. Jones and Burks (143) discussed experimental studies dealing with personality, three-fourths of which are concerned with infants and children under six years of age. Pintner (180), in summarizing intelligence tests, and Maller (166), in summarizing character and personality tests, devoted considerable space to infant and preschool levels. Wenger (218) reviewed the investigations on conditioned responses in infants. Wenger and Williams (216) summarized studies of learning in infants and preschool children. Meek and Jersild (170) covered mental development from two to twelve years, and Cattell (83) covered the period of infancy. Richards and Irwin (187) examined the literature on plantar responses and gave a bibliography of 117 titles.

Psychological Scales for Infants and Preschool Children

Recent research on scales used for testing general mental development of infants and preschool children has consisted chiefly in revising, refining, and extending the age range of the scales which are now in use, rather than in devising new ones.

Gesell's norms of infant growth—Gesell and others' volume (114) is organized as a practical manual, although it combines some monograph features. A developmental examination, a cumulative behavior inventory, and physical measurements are provided for each lunar month interval through the fifty-sixth week. The examination follows the general procedure presented in Gesell's book, *The Mental Growth of the Preschool Child*, and the normative summaries of preschool development, taken from this volume, appear in the appendix. This earlier volume is now out of print and a revised handbook of procedures and norms is in preparation.

Bühler's tests—Bühler and Hetzer (81) revised and extended the age range of Bühler's earlier test; formerly it was for infants only, covering

¹ Bibliography for this chapter begins on page 320.

EDITORIAL NOTE: Studies of development, reported briefly in this chapter, will be covered more completely in the issue scheduled for February 1939, *Mental and Physical Development*.

the period from two to twenty-four months. The revision extends through the sixth year. Some of the pictures included in the test materials are not appropriate for American children at the preschool level, and modern methods of scaling were not used in constructing the scale. It appears to differentiate well between levels of development, however, and is valuable for sequential study of the individual child. The tests for each developmental level may be grouped into six categories as follows: sensory reception, bodily control, social behavior, learning, manipulation of materials, and mental production. The child's score can be quantitatively and qualitatively analyzed.

Other tests—Based on an analysis of 650 records of children, Fillmore (104) devised a scale composed of 49 items which will be applicable to infants aged four months to twenty-four months. Although the internal consistency of this scale is reported as satisfactory, "it is not claimed that the growth pattern measured is equivalent to what is subsequently termed mental age." The score as a whole correlates with later intelligence quotients .03 to .48. The New Revised Stanford-Binet Tests of Intelligence (202), the International Performance Scale (156), and the Haut Rational Learning Board (173) cover the preschool age range. The California Scale of Motor Development, devised by Bayley (72), is applicable to children under thirty-seven months of age. Kasambi (144) described a series of six problem-solving tests which are adapted to Indian children above nine months of age.

Applications of tests—There have been numerous reports of the applications of the Bühler tests to different groups of children. Hubbard (131) tested and retested 78 infants at intervals averaging four months, by means of the Bühler test, and established alternate-item reliability coefficients above .98, a retest reliability of .70 for the first and second tests, and .94 for the second and third tests. Correlations with ratings on Merrill-Palmer tests administered at later ages were higher than those reported for any other infant and preschool scales. Herring (124) also checked the reliability of the tests on 114 different subjects, between the ages of one and fifteen months, and concluded that although the tests seem to indicate a fair degree of reliability over a limited time interval, there was little consistency in scores over a period of several months. Both Hubbard and Herring concluded that the Bühler tests may be too easy for American babies, and since the administration of the tests is not well standardized, it would seem that they are more valuable as clinical than as research instruments. Other reports of the results of the Bühler tests are by Wolf (221) on Viennese children; Iwai and others (136), and Hofstatter (128) on Japanese children, and Reichenberg (184) on a study of cultural influence on the development of the child. Curti (88) reported that 76 Negro children of Jamaica, aged from one to three, who were tested on the Gesell Developmental Schedule were below the norms. For these children the validity of certain test items is questioned because their performance was irregular and inconsistent.

Doscher (100) completed correlations between the Kuhlman-Binet tests and the Randall's Island Performance Series. Results indicated that in grading those children who are not fitted for verbal tests, the Randall's Island series is satisfactory and can be used for comparing the verbal and motor aspects of intelligence.

Rating Scales for Young Children

Specific functions—Williams and others (219) studied the language development of 285 children, between the ages of one and eighty months, and devised a tentative scale of language achievement covering these ages. A revision of Smith's vocabulary test for preschool children was presented (219: 33-46, 79-87). The importance of environmental factors in determining both the extent and the maturity of children's vocabulary was stressed. Based on a representative sampling of 100 children between the ages of five and one-half and six years is Hildreth's study (127) of their readiness for initial instruction as "typically organized in primary grades." She constructed a readiness test for pupil aptitude for primary learning, and concluded that the best and poorest learners can be predicted. Seltzer (191), using the Thurstone technic of scaling attitude scales, devised two scales for nursery school children, one containing 42 statements, which tests singing ability; and the other composed of 44 items, which tests rhythmic ability. A color-form test for young children based on the Dearborn color-form test was constructed by Forbes (106).

Other scales—Key and others (148) constructed a scale for grading the dressing skills of nursery school children. Experiments with 25 boys and 20 girls, aged nineteen to sixty-four months, showed that the child's age or maturation is of more importance than training. Fales (102) constructed a reliable rating scale by which the degree of vigorousness of preschool children's play activities can be measured. Experiments using this scale disclose a striking similarity between the vigorousness of the activities of boys and girls (103).

Social behavior—Van Alstyne (211) devised a scale for rating social behavior and attitudes from the nursery school through the sixth grade. It consisted of thirteen situations and their response levels. Doll (99) evolved a Genetic Scale for Social Maturity which consisted of 117 items. The age range is from infancy through adult life. Ten familiar nursery school situations were reproduced and scaled by Joel (140) to rate behavior maturity in nursery school children. Studies by Washburn and Hilgard (212) are in progress by means of which it is hoped further to objectify observations of social behavior of children between the ages of fifteen and fifty months. Bowley (79) developed a scale for rating the sociability of young children which combines qualitative and quantitative methods. Williams (220) made a factor analysis of Berne's Social Behavior Patterns in Young Children, and concluded that this type of analysis might be used to increase the effectiveness of the scale and to eliminate from it certain ambiguous items.

Psychological Measurements of the Newborn Infant

Investigators in the field of infant psychology and physiology have been active to ascertain what behavior is possible at birth, the changes that take place in the growth process, and how they are brought about. Responses during the first ten days of life have been most thoroughly studied because the infants are available for observation in hospitals and are subject to partial control. The problem is not to determine the infant's characteristic mode of reaction in his protected environment, but to elicit responses or fluctuations in responses which he is capable of making to experimentally controlled stimuli of varying intensity, frequency, and duration. Many of the studies are preliminary and inconclusive.

Reaction to color and light—Color vision in newborn infants has been investigated by J. M. Smith (195, 196) and by Peiper (179). Different methods were used by each experimenter and present results appear to be contradictory. J. M. Smith (195) studied the influence of visual stimulation on crying. Weiss (214) found that an increase in the intensity of light resulted in a decrease in bodily activity. This result has been substantiated by Irwin and Weiss (132, 134) and supplemented by Richard's studies (186, 188) of the relationships of bodily and gastric activity in the neonate. Redfield (183) studied dark adaptation in 47 infants by lengthening the dark periods and holding light intensity constant. She reported that bodily activity decreased following lengthened periods of dark.

Reaction to sound—Weiss (214) found that sound variations of different intensity also produced decreased activity. Visual and auditory stimuli which produced decrease in activity when presented independently, produced markedly greater effect when presented together. Stubbs (199) observed the effect of duration, intensity, and pitch of sound on the responses of 75 infants under ten days of age. Stubbs and Irwin (200) applied 50 stimulations of a tone of 580 cycles with a duration of .07 seconds to 6 infants. Reaction time of the body was measured by the stabilimeter, and respiration by a pneumograph attached to the infants' abdomens. With a loud tone the startle response occurred 70 percent of the time with an average reaction time of .19 seconds, whereas the respiratory response occurred 100 percent of the time with an average reaction time of .09 seconds. The respiratory reaction is the less variable measure.

Reaction to various stimuli—Sherman and others (192) studied 317 infants, from a few hours to sixteen days of age, using stimuli of precisely measured intensity, rate, and duration. Reactions of the eye, response to pain stimuli, movements of the limbs, response to pressure, defense reactions, grasping, and miscellaneous responses were quantitatively recorded and analyzed. It was found that behavior patterns were inconsistent. Daniels and Maudry (89), Dockeray and Rice (98) and Delman (92), studied the responses of infants to tactual stimulation. Although there was some patterning, the results showed that there was a tendency toward mass action rather than specificity of response. Taylor (201) applied "rage" and "fear"

stimuli as described by Watson to 40 infants, aged from one to twelve days. No constant pattern of response was evoked by the different stimuli. Irwin and Weiss (133) found that 94 percent of the newborn infants studied showed less activity and crying when clothed than when unclothed. Crudden (87) investigated the threshold sensitivity in 9 sleeping infants between two and forty-four days of age.

Palmar and plantar responses—Wenger and Irwin (217), measuring the amount of palmar and plantar skin resistance to electrical currents of fifteen newborn infants and six adults, concluded that increase in resistance is not a criterion of sleep, but that these increases in resistance are related to muscular relaxation. Pratt (182) made an extensive study of the generalization and specificity of the plantar response in newborn infants. Richards and Irwin (187) concluded from an examination of the experimental literature regarding the plantar responses, that there is much disagreement in the reported findings. Utilizing improved technics on 264 subjects under sixty-six months of age, they carried out experiments to check certain discrepancies. They found that no typical response was revealed, and concluded that the plantar responses are variable, less active with age, and become negligible at about the fifth year.

Opisthotonoid reaction—Irwin (135) analyzed cinema records of the opisthotonus or backward curving of the vertebral axis, made of a group of normal infants during the first two years of life, for transformation of this behavior pattern in relation to age. The possibility of using this reaction as an index of development is suggested.

Patellar reflex—Hazard (123) obtained patellar reflex time measures from 399 subjects ranging in age from birth to twelve years. "Reflex time increased gradually with age within the age limits of the study. . . . Conducting rate increased rapidly with age from birth to six years; more gradually from the sixth to the twelfth."

Conditioned reflex response—On the basis of a study of three infants eleven days to one month of age at the beginning of the experimentation, Kasatkin and Levikova (145) concluded that, in response to auditory stimuli, conditioned alimentary reflexes appear at the forty-fifth day of life. The main role is played by age and not by the number of stimulations. Considerable individual variation is apparent in the simplest auditory differentiation. Auditory differentiation already formed, may disappear under the influence of outer or inner factors. Wenger (218), using improved technics, investigated the conditionability of the neonate and concluded that although some forms of conditioning were possible in some infants as early as the fifth day after birth, retention is low, the responses are unstable and not easily obtained.

Motor Development

The emergence and growth of specific motor patterns of the same individuals at successive ages have been studied by direct observation, supple-

mented by the analysis of cinema records. Gesell and others (114) presented in normative gradations the sequential response of infants to specific situations from the earliest manifestations to the established patterns. Halverson (119) investigated the complications of the early grasping in infants aged four to twenty weeks. Early grasping was described as a two-phase activity of closing and tightening the fingers, which is not confined to the hand but is part of a total dynamic closure pattern. Gesell and Halverson (109) investigated the emergence and development of motor coordinations involved in thumb opposition in infants at successive ages from four to fifty-six weeks. Gesell and Ilg (111) presented the sequential development of the behavior manifestations and mechanisms of feeding, based upon consecutive observations of infants. Existing information on the development of upright posture has been supplemented by Thompson's careful and detailed study (203). Cinematography has proved to be especially useful in analyzing motor development and it has been used extensively for this purpose. Numerous films are now available for scientific study, a few of which are enumerated (108, 110, 112, 113, 115, 135, 160, 206, 207, 208, 209, 210).

The effect of exercise—Dennis (94), in his consecutive observation of fraternal twins, from birth to the fifteenth month, reared under restriction on reaching, sitting, and standing, concluded that retardation as compared with existing norms was the result of the restrictions, since with subsequent exercise normal standards were achieved. The effect of exercise upon certain motor performances was investigated by McGraw (161) by the method of co-twin control. Daily exercise was given the experimental twin from birth to twenty-two months of age. The control twin was restricted in motor activities until his twenty-second month after which he received for a period of three months the same training as the experimental twin. Achievement and persistence of the experimental twin were markedly accelerated.

Locomotion—In contrast to Herrick's theory, Levy and Tulchin (152) concluded from their study of "all four" locomotion that this pattern occurs much more frequently than is commonly supposed, and when it appears, is a part of an orderly process in locomotor progression between the creeping and standing stages.

Racial comparisons—In comparing the motor abilities of Negro and white children between two and five years of age, Rhodes (185) reported that there is striking similarity between the rate of motor development and the organization of motor abilities in the two races. Harmon's study (120) of 133 children—Italian, Mexican, Negro, Jewish, and Indian—revealed marked differences in reaction time between the groups. The Italian children showed a more mature type of reaction age for age, and the Indians were found to be slower than the other groups tested.

Handedness—Dennis (96), in a study of non-identical twins that were not conditioned by right-handed or left-handed presentation, found that lateral preference developed in dissimilar ways. Roos' study (189) of

486 cases failed to reveal, within the age range of the experiment, any causal relationships between handedness and the dominant position of the fetus, the birth position, or weight of the child, or to the basal metabolism rate of the pregnant mother. Kraskin (151) concluded from a study of handedness in four age groups, from infancy to early adulthood, that handedness is a specific individual trait which is not related to intelligence, prenatal environment, or age.

Mental-motor correlations—Mental-motor correlations have been studied by Bayley (74). Comparing the mental test scores and the motor test scores of 61 infants tested at monthly intervals from birth to three years of age, she concluded that motor growth is more rapid than mental growth for the infants studied up to the age of twenty-one months. Functional independence of intellectual ability and motor ability increase gradually as maturity proceeds and therefore are more closely related in infancy than in adulthood. Growth curves show that both mental and motor growth proceed more rapidly in the early months and are decelerated later. From a report based upon mental and anthropometric measures of 125 girls and 127 boys, examined at successive ages between twenty-one months and seven years, Honzik and Jones (130) concluded physical and mental superiority are to a slight degree associated.

Mental Development

Sequential stages in mental growth are expressed by the infant in his adaptive behavior throughout the situations which Gesell and others (114) summarized. Blatz and others (75) reported the results of tests administered to the Dionne quintuplets at bimonthly intervals from the eleventh to the thirty-fifth month of life. Gesell's developmental schedule was used throughout, supplemented by the Kuhlman-Binet and the Merrill-Palmer scales. The results are quantitatively and qualitatively analyzed and are presented in a series of graphs. The mental development of the five children is below the norms and is not identical.

Cultural influences on mental test ratings—Wellman (215) studied the effect of preschool attendance on mental test ratings, and showed that children who had attended the university preschool made higher scores on American Council on Education Tests and college examinations than did a comparable group without nursery school experience. Coffey and Wellman (84) studied the changes in intelligence quotients of more than 400 children in relation to fathers' occupations and the education of parents. Skeels (194) studied the mental development of 73 children in foster homes and found that the mental level of these children was higher than would be expected from the educational, socio-economic, and occupational levels of their true parents. Studies of mental development as related to institutional environment have been made by Crissey (85, 86) and Durfee and Wolf (101). Bayley and Jones (73), in a cumulative study from infancy to six years, investigated environmental correlates of mental and motor

development. The composite rating for socio-economic factors showed slight or negative correlation with mental test scores to eighteen months. Coefficients increased steadily thereafter. The relation of the different socio-economic factors to mental test scores and to age was presented.

Sequential studies of specific functions—M. M. Lewis (154) used the biographical method in his study of infant speech recorded in phonetic script from the earliest utterances. M. E. Smith (198) studied 220 children between the ages of eighteen and seventy-two months in regard to some of the factors which influence the development of the sentence. Hildreth (126) traced the developmental sequence in name-writing of children three to six and one-half years of age with a median I. Q. of 120. Block-building in young children was studied by Guanella (117). The stages observed were as follows: non-structural; linear (at about ninety-seven weeks); areal (at one hundred and fifty-three weeks); and tridimensional (at about one hundred and ninety weeks).

Incidence of specific functions in relation to age—Nelson (173) analyzed the performance records of 67 preschool children, from twenty-six to sixty-four months of age, and ranging in I. Q. from 96 to 168. In dealing with a simple problem in rational learning the children, while requiring more time and making more errors, follow adult patterns. Children as young as three years show the ability to eliminate logical errors. Somewhat in contrast to this study is Maier's study (162) reasoning in 39 children from forty-three to ninety-five months of age, which indicated that reasoning ability, as inferred from performance on the experimental problem, is relatively late in maturing, rarely developing to any marked degree below six years of age. The ability matures at widely different ages and its appearance is related to mental age. Mallay (164) investigated the latent memory span of nursery school children. Gutteridge (118) observed 417 children aged two to five years in play and reported the average attention span in relation to age. Thrum (205) investigated the development of concepts of magnitude in children aged twenty-four to fifty-four months. Markey (167) investigated the imaginary behavior of 54 preschool children from records obtained during their free play, and in experimental situations.

Davis (91) studied 436 children from five and one-half to nine and one-half years of age as to the use of proper names. M. E. Smith (197) studied the speech of eight bi-lingual children and concluded that the rate of error is higher than that reported for two- and three-year-old mono-linguals. Change to bi-lingual environment is more difficult for an infant under eighteen months of age than for those who are more advanced in age. Olson and Koetzle (175) devised a reliable method for recording the amount and rate of talking in young children between the ages of forty-six and sixty-eight months. Quantity of talking in young children is not an index of mental capacity. Quantity and rate yield a correlation of .13. Individual differences are pronounced, and boys tend to speak less but at a faster rate than do girls during a given period of time. Davidson (90) investigated the letters which are confused and the extent of this confusion

among kindergarten and first-grade children. She found that errors, with one exception, fall into reversals and inversions. There is a marked decrease in the percent of errors with increase in mental age, and children pass through certain stages of development before they are able to distinguish *b*, *d*, *q*, and *p*. A larger percent of boys than girls make the errors studied, which is important since boys present a larger number of reading difficulties.

Using the technic of Peck and Walling (177), Peck and Hodges (178) investigated the eidetic imagery of white, Mexican, and Negro children of preschool age. The results indicate that the Negroes possess a higher degree of eidetic ability than do the white and Indian children. Recent experiments on color and picture preferences among young children include a study by Hildreth (125) which established orange as the favorite color, with pink second, and red third, for a group of 78 boys and 60 girls, aged three to six years. Olney and Cushing (174) recorded the time each of 56 nursery school children spent in looking at various types of pictures, and found mechanical subjects involving people the most popular, and small animals, silhouettes, and animal activities the least popular. Jersild and Bienstock (138) found from observation and detailed analysis of cinematic records on 94 children and 17 adults that scores on accuracy in keeping time to music rose substantially from two to five years and that adults scored about twice as high as five-year-olds. Five subjects were given opportunity to practice and their final average score was almost twice as high as the initial score. Much of the change during practice arose through cooperation and interest, as distinguished from improvement in ability.

Personality Development

Sequential studies of emotional behavior—The study by Blatz and Millichamp (76) of emotional development in infancy was based upon five children who were observed by mothers in the homes for emotional episodes from birth to the second year of life. Types of behavior and the frequency of their occurrence in relation to age were presented. Based on the systematic observations of 127 children and supplemented by the findings of others, Bridges (80) discussed the emergence and differentiation of the primary drives and presented a schematic outline of their development.

Incidence of emotional behavior—Dennis (95) concluded from his systematic observation of twins that smiling is a conditioned response which becomes attached to any stimulus which leads to relief. Blatz and others (77) concluded that laughter and probably smiling may be considered as "socially acceptable tics" or compensatory motor mechanisms accompanying the resolution of conflict. Jersild and Holmes (137, 139) have used various approaches in the studies of children's fears, including an experimental study of 105 nursery school children. The fears are analyzed and reported in relation to age, sex, intelligence, and socio-economic status. Holmes (129) followed this with an attempt to overcome

fears. Foster and Anderson (107) investigated unpleasant dreams in children aged sixteen months to twelve years. The types of dreams and their frequency are reported in relation to age and other factors. Schramm (190) compared the responses of children to animals in various situations. S. J. Lewis (155) discussed the problem of thumb-sucking from its effect on physical structure, and Levy (153) considered it from the psychiatric angle. They concluded that it is not possible to generalize about this activity since it arises from highly specific and complex individual needs. An analysis by Koch (149) of certain forms of "nervous habits" in nursery school children observed in 400 one-half minute periods during eight months suggested that many factors such as local irritations, the gross bodily movements involved in the activity, boredom, internal conflict, restraint, and degree of aggressiveness, contribute to mannerisms. Blatz and Ringland (78) observed 71 children between the ages of two and seven years in half-hour periods at various times during the school day to discover the frequency, nature, and origin of tics. They concluded that tics are extremely common among children of these ages—and are more frequent when gross bodily movements are inhibited. Tics involving the mouth are most frequent.

Culture and emotional patterns—Hattwick's findings (122) on the interrelationships between certain factors in the home and the behavior of 335 children between the ages of twenty-three and sixty-eight months tend to agree with former studies, notably Fitz-Simons (105), which showed that children whose homes reflect overattentiveness are liable to display infantile, withdrawing types of reaction and that inadequate attention in the home and aggressive types of behavior in children are related.

Emotional concomitants of behavior—Johnson (141) devised three experimental situations in which eight nursery school children were motivated progressively to attain a recognized goal in the face of annoying or fear-provoking interference. Results indicate marked variation, from complete withdrawal to persistence. Kendrew (146) studied the persistence of moods experimentally aroused in children from five to seven years of age, and their effect on a natural rate of working. In nine out of twenty cases disappointment appeared to decrease the output in subsequent activity. In eight cases it increased the energy output. McClure's study (159) of the effect of varying verbal instructions on the motor responses of 39 children ranging in age from twenty-seven to seventy months showed that encouragement was more effective than discouragement, and emphasis on success more effective than emphasis on failure at the ages studied. Reward as motivating factor in child learning seemed to act more strongly than an unpleasant incentive in an experiment by Mast (168) with 43 children aged thirty to seventy months. Mayer (169) observed the resistant reactions of 277 children below six years of age to the New Stanford-Binet Scale and found that negativism is most frequent at thirty-six months.

Incidence of social development—Two trained observers recorded the social behavior of the Dionne quintuplets from the twelfth week to the

thirty-sixth month of life (75). Mallay (165) in a study of 21 children aged twenty-four to fifty-seven months, concluded that learning by experience is more important in establishing successful social contacts than is maturation. Portenier (181) concluded, from the observation of 25 children, aged two to five years, that social adequacy is largely a matter of integration and is the result of the total situation and the elements which have influenced the development of the individual child. Murphy's excellent studies (171, 172) of sympathy in young children revealed, in addition to general trends related to age and intelligence, that specific characteristics of the situation determine behavior.

Effect of culture on social development—Anderson (69, 70) extended a previous study which showed that the Iowa University Nursery School Group is significantly more integrative and less dominative than a nursery school group and a non-nursery school group in an orphanage. Combined data for all groups indicated that girls are significantly more dominative than boys, and that boys are more integrative than girls. A study by Mallay (163) of 21 nursery school children, observed in the fall and six months later, showed an increase in social behavior.

Effect of training on behavior—Keister and Updegraff (147) contributed a study on the reactions of 82 children to failure. They reported that after a period of training children tried longer, manifested more interest in solving problems independently, and eliminated undesirable emotional behavior. This improvement was not believed to be a function of age but was the result of a program of training. Page's work (176) with groups of nursery school children indicated that experimental training to increase self-confidence was effective in increasing manifestations of ascendent behavior of children as young as three years.

Method

Washburn (213) devised a simultaneous observational and recording method with a list of 20 symbols to be used in recording the various activity patterns in young children during the free play period. Loomis (157) pointed to certain pitfalls in applying the objective sociological method to the study of children and presented the general aim for further development of the method. Arrington (71) discussed the progressive refinement which has taken place in the time-sampling method in studies of the incidence and patterning of various kinds of behavior in young children. On the basis of various empirical tests, she reported that the usual measures of average tendency and variability are applicable to irregular and J-shaped distributions obtained, except in cases where the sampling is inadequate. Harris (121) suggested a method of recording overt attention quantitatively during a test situation. Goodenough (116) recalled the many sources of error in the past that have accompanied the naive and superficial use of the time-sampling technic. She suggested the experimental approach in the study of child behavior whenever the problem under consideration can be

adapted to the laboratory setup. Koch (150) reported the results of a multiple factor analysis of certain measures of activity in nursery school children. M. C. Jones and Burks (143) reviewed the field of factor analysis and critically considered its implications for the problems under consideration. Shock (193) devised an apparatus which provides continuous, simultaneous photographic records of physiological processes which H. E. Jones (142) adapted and supplemented. The experiments reported appear to be satisfactory. Dennis (93) compiled a bibliography of some 64 baby biographies of infants under three years of age. McCarthy (158) contributed a graphic age converting scale which covers the ages from birth to five years. Campbell and Breckenridge (82) studied the complex problem of cumulative record keeping for the individual child which will most completely reveal the various growth processes and their interrelations through time. Thompson (204) discussed the inadequacy of the test construction criterion "increasing ability at successive ages" for properly assessing infant development.

Summary

During the period covered by this review there has been increasing precision in the methods used for investigating the newborn infant, resulting in more objective, quantitative, standardized studies. Infant norms are more finely graded and are presented in intervals of weeks or lunar months. Several scales for children at the grade-school level and above have been extended to include the preschool level. Emphasis is placed upon the quantitative and qualitative analysis of the separate items of the scale as well as on the total score in developmental diagnosis. In studies of preschool children the various factors are usually reported in relation to the mental age and intelligence quotient. Many of the subjects of these studies come from highly homogeneous groups with respect to intelligence, usually well above the level of the general population, which probably tends to lower the correlation reported between mental status and other factors. Rating scales and tests of specific abilities are numerous. More interest is evidenced in social and emotional behavior. Their incidence is reported in relation to age. Highly significant data are being obtained from cumulative growth studies of the same individuals studied intensively in interaction with environment.

CHAPTER IV

Applications of Intelligence Testing¹

NOEL KEYS

DESPITE LACK OF AGREEMENT as to the nature of intelligence, and uncertainty as to the precise significance of so-called "intelligence tests," the indispensability of these instruments is attested by the continual recourse to them. The literature on applications is increasing in what seems almost geometrical progression. The bibliography for this chapter has been chosen from more than five hundred titles considered by the writer. Major considerations in the selection have been the importance of the problem treated, the objectivity of the data, the adequacy of sampling, the apparent statistical justification for the findings, and, to some extent, the novelty of the conclusions reached. Preference has also been given to publications most widely available to American research workers.

1. Application to the Study of Individual Differences

Human Variability

Analyzing the range of capacities in a wide variety of functions Wechsler (394) discovered that in only 5 of 72 comparisons did the individual ranking 999th in a thousand exceed the ability of the individual ranking second by more than 2.7 times—or the Napierian base, e . From this he ventured the hypothesis that there are biological limits to human variability which generally serve to restrict it to a ratio of less than three to one.

The irregularity of ability profiles among morons was studied by Durling (272); among university freshmen, by Chen (254); and among ten-year-olds selected as having I.Q.'s between 90 and 110, by Stout (385). In emphasizing the extreme unevenness of abilities in a given individual these writers took no account of possible errors of measurement.

Problems of Nature and Nurture

Several major contributions during the last three years would seem to have increased the weight assignable to environmental factors as determinators of mental differences.

Twins—The Chicago twin study of Newman and others (346) saw full publication in 1937. Their intensive comparisons of 50 pairs of fraternal twins reared together, 50 pairs of identical twins reared together, and 19 pairs of identicals reared apart, pointed to the conclusion that the ratio of the contributions of nurture to those of nature fluctuates greatly, depending

¹ Bibliography for this chapter begins on page 327.

apparently on whether heredity or environment varies more widely in the situation considered. Richardson (359) inferred that the similarity in environment of twins is sufficient to increase their innate resemblance from an r of .50 to one of .81.

In a novel approach especially remarkable for the number of cases assembled, Rosanoff and associates (362) analyzed the comparative incidence of mental deficiency other than mongolism in 126 pairs of monozygotic and 240 pairs of dizygotic twins having one or both members of each pair affected. They concluded that hereditary and germinal factors, while important, are by no means essential to mental deficiency, and that the evidence points to cerebral birth trauma as an etiological factor of utmost importance. Byrns and Healy (244) discovered an inferiority of 10 percentile points in average intelligence scores among twins as compared with other high-school pupils.

Foster children—A study by Leahy (331) of 194 children adopted under six months of age is noteworthy for the exceptional care with which factors operating to induce selection in placement appear to have been excluded, and the foster and true parent groups matched as to occupational status, urban residence, and the like. Under these conditions, the I.Q.'s of the adopted children showed a corrected correlation of only $.21 \pm .06$ with intelligence of the foster parents, as contrasted with a resemblance of $.60 \pm .03$ between a matched group of true parents and their children. Schott (368) reported no significant gain in the I.Q.'s of 200 Michigan children following placement in foster homes. Skeels (375), however, found 73 adopted children to show a median Stanford I.Q. of 114 and a Kuhlmann-Binet of 116, though born of parents of educational and occupational status markedly below average. These quotients, however, were obtained at an average age of only twenty-four months, and ran ten points lower for those children over thirty-six months.

Parental occupation and home environment—For 1,000 ten-year-olds in Czechoslovakia, mean Binet I.Q.'s ranged from 90 for children of day laborers to 117 for those of university educated parents (257:803-807). Differences between social groups under American conditions, however, appeared somewhat less extreme (234, 247, 293). A study by Byrns and Henmon (246) of 100,820 high-school seniors showed children from the highest occupational classes deviating more widely from the average than those from the lowest groups. H. S. Hill (305) and Arsenian (227) found bi-lingualism reflected scarcely at all in the I.Q.'s of American children of Jewish and Italian families, considered separately. Children four to nine years old provided with improved housing by a British slum clearance scheme showed small but significant gains over a control group, according to Dawson (264).

Educational and social environment—There is accumulating evidence that the influence of schooling upon intelligence may be less negligible than studies of a decade ago would make it appear. Wellman (395) reported

students having six or more years of attendance in Iowa University demonstration schools as consistently surpassing on intelligence tests at college entrance those of equal initial I.Q. but shorter attendance in these schools. Crissey (261) found children in institutions for the feeble-minded showing an average *decline* of 4.9 points in I.Q., as against a *gain* of 2.3 for a like period by orphanage residents of the same initial I.Q. One wonders whether this result might not reflect subtle selective factors which influenced the original commitments.

The effect of improvement in reading upon measured intelligence continues in dispute. Scruggs (369) noted a gain in the intelligence of Negro children under remedial instruction, whereas Hawthorne (300) obtained a correlation of $-.17 \pm .07$ between changes in I.Q. and in reading scores among 104 fifth- to twelfth-grade pupils selected for special instruction because of reading disability. Lazar (330) has also made a study of the reading interests of children. Klineberg (323) reported further evidence of the relation of intelligence in Negro children to length of stay in city, and Pieter (350) obtained a correlation of .80 between social environment and the I.Q. of children in Poland.

Implications for eugenics—In certain Devonshire districts with much intermarriage, 54 percent of the children tested were mentally deficient, according to Rau (355). The high negative relation between fertility and occupational classes in Great Britain was analyzed by Bradford (233) and Cattell (249). The latter concluded that though the national intelligence is declining but 0.1 I.Q. point per annum, the effect on the extremes of the distribution is pronounced. In one generation the percent of city residents with I.Q.'s above 120 is likely to be diminished by 35 percent. From American data, however, Shuttleworth (373) reasoned that more than half of the detrimental effect of present differential birth-rates can be attributed to the poor environment of children of the lower classes. His contention adds point to new evidence of the gross inequality of opportunity in English education (296). More than 50 percent of children with Otis I.Q.'s of 130 or above were found to be without opportunity for higher education.

Race and Sex Differences

Race and national groups—Porteus (353) found that Australian aborigines outscore Kalahari Bushmen on various tests of learning capacity. This he regarded as in keeping with the extent to which each group has succeeded in mastering its environment. On the American Council on Education Psychological Examinations at the University of Hawaii, Chinese students surpassed the American, Japanese, and part-Hawaiian groups on tests of artificial language and arithmetic. The Americans led on all other comparisons, with the part-Hawaiians usually ranking lowest, according to Livesay (332, 333). Byrns (243) compared the intelligence of Wisconsin school children of thirty different nationality groups, and Garth and others (286, 287) reported further data on Mexican children in the South.

west. Their inferiority was shown to be greatest on verbal measures of intelligence and school achievement, while on the Pintner Non-Language Test, they virtually equalled the white controls. From a survey of the literature comparing intelligence scores of Negroes and whites, Witty and Jenkins (400) concluded that the differences observed are probably attributable to factors other than heredity.

Sex—Little of importance has been added to our knowledge of sex differences in intelligence. Kirihara (322) found Japanese males excelling females on four types of tests, except at certain ages below twelve. Terman's contention that gifted boys outnumber girls at high-school level by two to one, however, was challenged by Witty (401), who discovered 0.32 percent of boys as compared with 0.35 percent of girls testing above 140 I.Q. Among Negroes in Grades III to VIII, girls with Stanford I.Q.'s over 120 proved more than twice as numerous as boys (315).

2. Studies of the Relation of Intelligence to Other Traits

Physical Traits

Growth and development—Repeated measurements on 252 children examined at intervals from twenty-one to eighty-four months of age were analyzed by Honzik and Jones (310). These disclosed a correlation between height and intelligence of .19 at seventh birthday. Both height and weight showed a residual relationship with mental superiority, even with socioeconomic index constant. The tendency toward subnormality among victims of puberty praecox is well attested (321); but in a normal population, a small though insignificant superiority of 2.25 I.Q. of postmenarcheal over premenarcheal girls of like age was ascertained by Stone and Barker (384).

Appearance—Hollingworth (308) obtained photographs under uniform conditions of forty fourteen- and fifteen-year-olds with I.Q.'s of 135 to 190, and a control group with I.Q.'s of 90 to 110. When these were rated for beauty, the highly intelligent subjects averaged consistently higher by several methods of comparison, with differences amounting to about 1 A.D. of the distribution.

Health factors—Brander found lower mentality associated with rickets (236), enlarged tonsils (237), and low birth weight (235) among 376 school children of premature birth. Children receiving treatment for allergies, chiefly asthmatic, proved fully equal in intelligence to non-allergic controls, and little if any more retarded in school (389). The experimental literature showed little evidence of any marked influence of diet upon intelligence scores, according to Fritz (284), though achievement may be impaired thereby. Physical ailments were found to be accompanied by reduced accomplishment ratios on the part of high-school pupils, and particularly those of over 115 I.Q. (382). Hinton (306) studied the basal metabolism

of 90 five- to fifteen-year-olds free from physical disturbances other than subactive thyroids. For this group metabolic rate correlated no less than .74 with Stanford-Binet, and .66 with Arthur Performance Scale quotients. A follow-up by Baller (229) of special-class children in Nebraska averaging 60 I.Q. showed a death-rate seven times that of a control group with I.Q.'s from 100 to 120.

Athletic and motor efficiency—Athletic achievement continues to reflect positive but low correlation with intelligence. This appears traceable more to lack of success by the dull than to superior performance of the brightest students (318). Among boys in special classes for the mentally deficient, correlations of physical ability tests with intelligence ranged from low to marked, depending on the complexity of the feat (370).

Social Traits

Personality and interests—Thirty-five out of 78 English children with I.Q.'s of 140 to 180 brought to the Psychological Centre were "difficult" in some respect, and "not less than ten" were definitely unhappy in school, according to Nevill (345). Hollingworth (309) held that children with I.Q.'s from 125 to 155 have best prospects of developing successful and well-rounded personalities. The intelligence of college students was found unrelated to introversion or emotional stability (407), to frequency of anger (339), and to attitudes toward war (280).

G. B. Smith's investigation (377) of the high-school and college activities of 512 University of Minnesota students from 1925 to 1929 showed that publications and dramatics had attracted the more intelligent of both sexes at both school levels. Athletics and musical and social activities drew a less capable group in high school, and religious organizations in the university.

Character and conduct—In a work of uncommon scope and thoroughness, Chassell (253) synthesized the evidence from nearly three hundred studies in psychology, sociology, and criminology bearing on the relation between morality and intellect. On the basis of these, supplemented by two original investigations, she concluded that, in groups of restricted type and range, intelligence and conduct will show correlations of only .10 to .40, with the true agreement falling somewhere below .50. In the population at large, however, the correspondence would undoubtedly be greater, though scarcely as high as .70. Thorndike (390) also published a reanalysis of the relationship between morality and intellect in members of the royal families of Europe, as studied by Woods three decades ago. After allowing for the estimated influence of "halo" and the counteracting effect of inadequacy of data, he decided that the true correlation is not far from .60. (Intelligence in delinquent groups is treated later in this chapter, under the head of "Clinical Applications.")

Particular Talents and Abilities

Music and Art—Farnsworth (279) discovered no significant differences between tests of intelligence and of pitch and tonal memory as predictions of music grades of college students; but a controlled experiment with ninth-grade pupils reported by Lamp and Keys (326) indicated Terman Group I.Q.'s inferior to both pitch and tonal memory in forecasting performance on brass, woodwind, and stringed instruments. Two studies (391, 408) confirmed previous observations as to the low positive relationship between artistic talent and intelligence.

Miscellaneous—Davis (263) found a slight correlation between length of spoken sentences and the I.Q.'s of primary school children. Pupils with I.Q.'s over 120 showed less forgetting of difficult school subjectmatter over summer vacation than did those below 90, according to Kolberg (324). Ray (356) obtained a correlation of .89 between mental ages of twelve-year-olds and their success on 21 tests of ability to generalize.

3. Intelligence Testing for School Purposes

Surveys—Oakley (347) investigated the prevalence of psychological testing in the secondary schools of England, and Parsons and Moderow (348) the programs in 53 American cities. Eells (275) analyzed the returns from 198 schools participating in the Cooperative Study of Secondary School Standards; C. Woody (404), the showing of Michigan high-school sophomores on the American Council on Education Psychological Examination; and Royer (364), the statewide survey of Oklahoma high schools and colleges by means of the Ohio State Psychological Test. Much information as to differences in intelligence levels according to sex, region, size, and type of institution, and curriculums pursued is available in these reports.

Record systems—Hanley and others (298) developed a cumulative record system for English schools, and Embree (276) for American. The latter utilizes standard deviation scores to reduce test results and teachers' marks to a comparable basis.

Trend of Intelligence Scores

In high school—Despite reduction in failures and decreasing selectivity of secondary schools, two independent investigators reported a noteworthy rise in intelligence scores over a period of years. Roessel (360) discovered in three Minnesota towns a gain in mean I.Q.'s on the Miller Mental Ability Test in 1934 as compared with 1920, for each school grade from the seventh to the twelfth. For high-school seniors, the rise was from 118 to 122. Rundquist (365) reported an even more startling superiority of Minneapolis seniors in 1933 over those of 1929. Various possible explanations suggest themselves, not least of which would be the greater competency of examiners and increasing "test-wiseness" of pupils, as reflected in the findings concerning effects of practice on test scores (224). Six California high

schools showed a mean I.Q. of 104 in 1933, as compared with 108 in 1917 (230).

In college—The steady rise in intelligence of freshmen entering the arts college of the University of Minnesota from 1926 to 1934 is attributed by Williamson (397) to more intelligent guidance in secondary schools. College aptitude scores of Stanford University students showed a similar upward trend from 1923 to 1931, since when abandonment of competitive admission has led to a distinct reversal, according to Cowdery (260). An equivalent form of the Ohio Examination administered to 433 college students in their senior year revealed an average rise of 11 percentile points over their scores as freshmen (299). Lyon (336) noted a correlation of .44 between the mean intelligence in various Wisconsin high schools and colleges and the size of their respective graduating classes; and Cavan (251) observed a similar relationship with size of enrolment among colleges using the A. C. E. test, as well as a generally superior level of ability in private as compared with public institutions. The intelligence of students in evening and extension classes in upstate New York was surveyed by McGrath and Froman (337), H. P. Smith (378), and Strabel (387). Except in classes organized under the federal work-relief program, these students equalled or excelled corresponding on-campus groups.

Predicting Achievement in Elementary School

Rush (366), pointing out that most failures occur in Grades I and II and are associated more closely with mental than with chronological age, argued that standards for admission should be revised to take account of the former. The futility of grade repetition as a remedy for too early entrance is shown by Arthur (228), who found that pupils repeating the first grade did no better, if as well, as beginners of the same mental age. Woods and others (403) suggested that reading might well be deferred until the child reaches the mental level of the average pupil in high first grade, and reported the successful operation of "transition groups" for those considered not ready for promotion into high first. An interesting experiment with four beginning groups by Gates (288), however, indicated that the mental age necessary for success in beginning reading is by no means a fixed quantity, but conditional upon the teacher, and the methods and materials used.

Kyte (325) was impressed by the fact that 64 percent of 1,435 first-grade failures had I.Q.'s of 90 or above. This raises the question as to "why normal children fail to make normal progress." Horn and Main (311) studied the grade placement of pupils between 90 and 110 I.Q. in Los Angeles schools and found these strictly normal children to average one-tenth of a grade lower than they belonged by prevailing age-grade norms. These norms, however, included grade repeaters. When standards were calculated on the assumption that children enter first grade within six months of the minimum age permitted by law and progress regularly thereafter,

the 90 to 100 I.Q. group were found retarded by an average of .53 grades, or just over one semester. Present grade standards seem too severe for the average child.

Predicting Achievement in High School

General success—Mitchell (341), and W. H. Woody and Cushman (405) produced new evidence as to the high rate of elimination among pupils of less than average intelligence. Douglass and Wind (265), however, demonstrated that elimination is even more closely related to retardation, and to economic and cultural factors in the home. Of 1,373 pupils who failed in two major subjects in different semesters, those who graduated were found no different in age, and only five points higher in I.Q., than those who did not graduate (294). Stejskal (257: 783-94) obtained a correlation of .66 between a two-hour mental test and achievement in Czechoslovakian secondary schools, even though applicants scoring below the 40th percentile were discouraged from entering. Hughes (312) reported coefficients of similar magnitude between intelligence and achievement tests administered to competitors for secondary-school scholarships in England.

Embree (277) discovered no significant differences in the value of I.Q.'s of the three levels, 90 to 109, 110 to 129, and 130 to 149 for the prediction of honor-point ratios in senior high school. A combination of I.Q. and honor-point ratio in ninth grade was found to forecast average marks in tenth to twelfth grade, exclusive of music and physical education, to the extent $r = .89$.

Particular subjects—Several studies treat of the prognosis of achievement in specific subjects. Grinnell (297) observed Inglis Vocabulary scores to correlate .70 with average I.Q. on four tests, as against only .53 with an average of English marks over six semesters. He did not, however, correct for the higher reliability of I.Q.'s as compared with marks. For predicting achievement in United States history, Bolton (232) found the Wesley Test of social studies vocabulary superior to the Otis Group Intelligence ($r = .65$ versus .59). Hummer (313) reported Otis Group I.Q.'s below 100 to 110 indicative of failure in tenth-grade geometry, but the Otis Self-Administering Test gave an indifferent prognosis of physics achievement (376). From the literature concerning high-school mathematics, Douglass and Michaelson (267) rated both I.Q. and M.A. inferior to either special aptitude tests or average marks in previous year for predicting high-school mathematics. Dunn (271) cited evidence as to the closer agreement of algebra achievement with prognosis when classes taught by different teachers were considered separately. Earle (273) sought to arrange school subjects into unitary groups. He claimed that tests for vocabulary, algebra, geometry, and science will provide an adequate basis for educational counseling.

Predicting College Scholarship

An admirable summary of the literature to 1934 on the prediction of college success, by Segel (371), should be of service to administrators, counselors, and research workers. Its thirty-one tables present in convenient form the findings on a wide variety of intelligence, aptitude, and achievement tests, as well as high-school marks and other factors.

The numerous studies which have appeared over the past three years add little that is novel. From the showing of women students on Cambridge final Tripos, Dale (262) reached the conclusion that "the selection of students best fitted to pursue highly specialized degree courses does not appear to be made easier or more reliable by the use of mental tests." Root (361), Ficken (283), G. A. A. Jones and Laslett (317), and Drake and Henmon (269) are among those confirming previous observations as to the inferiority of intelligence and aptitude tests to percentile rank in high-school class for the prediction of college grades. Landry (328), however, found Cooperative Test Service scores and the College Entrance Board test of verbal aptitude, while less satisfactory than an adjusted average of twelfth-grade marks, nevertheless definitely superior to College Entrance Board examinations. Payne and Perry (349) reported that less than one in a hundred of students gaining scholarship honors and awards at the City College of New York scored below average on the psychological examination, and McQuitty (338) found that student mortality at the University of Kentucky was six times as high among those in the lowest 3 percent on the classification test as among those in the highest 3 percent. Others (316, 361) reported satisfactory results from a combination of high-school marks and tests of scholastic aptitude. Douglass and associates (266, 267) were unable to obtain a multiple correlation higher than .50 with college achievement in either mathematics or social studies, and but .57 with courses in history. Relationships in the case of mathematics were markedly curvilinear.

Factors influencing correlations—The influence of university practices on size of coefficients is indicated by various observations. Since comprehensive examinations have been made the sole measure of scholarship at Chicago, Reitz (358) noted an increased agreement between grades and scores on the American Council on Education Psychological Examination, and a slightly lowered correspondence with high-school rank. At Minnesota, Williamson (398) remarked a decline in the agreement between prediction and performance for successive classes from 1926 to 1935. This he attributed to the increase in average intelligence and reduced variability of classes along with other outcomes of improved counseling procedures.

Long-range forecasting—Of especial interest is a study by Byrns and Henmon (245) of the long-range prediction to be had from performance on the National Intelligence Test in Grades III to VIII. Quotients thus obtained correlated .81 with psychological tests at college entrance, .43 with the four-year average of high-school marks, and .45 with first semester grades in the University of Wisconsin. In view of the degree of prediction obtained, it is

noteworthy that the mean I.Q. of Madison students entering the University had been only 109.3 when in elementary school.

Informing Pupils of Scores

Despite a gradually growing public understanding of mental measurements, there is little agreement as to how best to utilize test results. Below college level the consensus of school authorities appears to be strongly against acquainting either pupils or their parents with records made on psychological examinations. So fearful are administrators of possible misuse of test results, that in many schools these are hidden carefully in central files to which even the teaching staff is forbidden access. There is evident need of experimentation concerning the effects of knowledge of intelligence scores by teachers, parents, and the children themselves. A study by Snyder (379) constitutes one approach to the problem. In an Ohio high school, any pupil who cared to learn his percentile rank on a schoolwide intelligence test was handed this information on a slip of paper, while all received a careful explanation of its significance. Three-fourths of those above the 30th percentile and half of those below that point took advantage of the opportunity. Questionnaire replies showed 72 percent in the lower three-tenths and 90 percent in the upper seven-tenths favored the reporting of scores in this fashion. Opinion was almost unanimous that high scores did not mean that one could succeed without working, or low scores that success was impossible. Other reactions seemed wholesome, and during three years of reporting scores no parent had objected.

Discrepancies between Promise and Performance

Individuals whose achievement differs widely from measures of their scholastic aptitude continue to attract investigators. Wolf (402) administered a variety of tests to 50 girls of Italian parentage doing unsatisfactory work in sixth grade, and to 50 others of similar Binet I.Q. but greatly superior achievement. So far was the failing group from indicating any special bent for non-verbal pursuits that the Detroit Mechanical Aptitude Test showed a significant difference in favor of the good students. Six measures of adjustment and interests all favored the successful, the difference being highly significant in the case of the Woodworth-Cady. Eckert and Mills (274) compared Buffalo high-school seniors whose Regents' Examinations placed them 1.2 σ higher on average than their intelligence scores, with a group whose Regents' averages placed them 1.2 σ lower. These groups differed widely in percent of retardation in high school and in extent of participation in club activities. Differences in socio-economic status were small; measures of studiousness, however, markedly favored the academically successful. Reeder (357), likewise, discovered scores on the Wrenn Study Habits Inventory to add slightly to the value of intelligence scores, and found bright Negroes doing failing work in junior high school to be charac-

terized by poor home conditions (269). Neel and Mathews (344) reported superior college students to be younger, happier, and participating in more campus activities but scoring more introverted and self-sufficient and less sociable on the Bernreuter Inventory than "non-achievers" of like superior intelligence.

The significance of relationship between achievement and capacity as an indication of good teaching is emphasized by Corey (258), who found performance on a regularly scheduled examination correlating $.52 \pm .05$ with Army Alpha scores, as against $.06 \pm .07$ in the case of tests sprung without notice. Specific measures for bringing the accomplishment of abler college students more nearly up to their potentialities are discussed at length by Starrak (381) and Wrenn (406).

Providing for Individual Differences

Ability grouping—Part I of the Thirty-Fifth Yearbook of the National Society for the Study of Education is devoted to consideration of the theoretical desirability and practical effectiveness of various types of pupil grouping. Chapter XV constitutes a review by Cornell (259) of the experimental evidence regarding sectioning for ability leading to the qualified conclusion that "when attitudes, methods and curricula are well adapted . . . results, both objective and subjective, seem to be favorable" to such grouping. (See the *Review of Educational Research* for October 1937.)

Special classes—Heck (302) summarized research on special classes for the mentally handicapped and gifted. Gates and Bond (289) reported interestingly on the practices of the Speyer School, established under joint supervision of Teachers College and the New York City Board of Education for experimentation with special classes for dull-normal and exceptionally bright pupils. Under a highly liberalized curriculum, the former showed large gains in reading ability and conspicuous improvement in behavior and attitudes toward schooling.

Acceleration of the bright—Several recent studies have combined to place in more favorable light the practice of accelerating bright students which has been a target for much criticism on subjective grounds. Sackett (367) studied children given special promotions in fourth or fifth grades. Eight semesters later they were shown to have gained more in E.Q. and A.Q. than those who had progressed normally, and teachers rated sixteen as having benefited from the acceleration to one who had not. Herr (303) compared 97 pupils selected to complete the work of seventh and eighth grades in one year with a control group matched for sex, I.Q., E.A., school citizenship ratings, and high-school curriculum. The accelerates slightly excelled in their high-school studies, while in social adjustment they "did not differ from their peers." A similar group interrogated at time of graduating from high school voted twenty-four to four that acceleration had not deprived them "of any honors or social advantages later in high school" (372). Wilkins (396) showed 282 pupils graduating from high school under seventeen

years of age to be superior in school achievement, while their ratings as regards interests, activities, and age of companions preferred were interpreted favorably. At Buffalo, Strabel (386) found boys and girls accelerated in elementary school surpassing matched groups in all high-school activities save athletics, and showing to better advantage in scholarship, student activities, and fraternity memberships in college.

4. Intelligence Testing in Occupational Studies and Vocational Guidance

A survey of large industrial and commercial companies indicated that intelligence tests are not now and never have been widely used in the selection of employees. This, Fryer (285) explained as due to practical considerations rather than any "disillusionment" as to the value of such measures. Scores on two intelligence tests given the entire force of a public utility company, for example, were found to correlate .68 with supervisors' ratings as to general value of the individual to the company (393). Selection of applicants in the light of their test scores served to reduce the percent of unsatisfactory employees by more than four-fifths. Army Beta tests of Czechoslovakian soldiers indicated 82 as the minimum I.Q. satisfactory for truck drivers, although men of I.Q. 94 performed as well as any group up to 115 (257: 278-84). For numerous other European reports of the use of mental tests in selecting and classifying military, naval, and civil personnel, the reader is referred to the *Psychological Abstracts* of the past three years and the *Proceedings of the International Conference of Psychotechnology* (257). For a discussion of aptitude tests, see Chapter V of the present Review.

Sizable groups of transient unemployed in cities of the United States and Canada have been examined with a variety of tests of abstract intelligence, mechanical and clerical ability by Brentlinger (238), Kaplun (319, 320), Morton (343) and Bryan (240). The last named found an average I.Q. among literate transients of 73 for the whites and 58 for the Negroes. A study of 206 former special-class pupils with I.Q.'s under 70 showed that only 39 percent had been able to hold a job for any extended period (229).

A follow-up by Proctor (354) of 1,500 adults tested on the Army Alpha thirteen years earlier revealed a significant difference of 15 points in I.Q. between those reporting an occupation and those naming none. Boardman and Finch (231), however, noted that College Aptitude Ratings below the 40th percentile for university students were entirely compatible with later employment in positions of superior grade.

Intelligence and Vocational Plans

Despite a decline of four points in the average I.Q. in six California high schools over a sixteen-year period, the percent of pupils in 1933 avowing the intention of entering semiprofessional callings was fully as great as in

1917, while the percent expecting to enter professions had decreased from only 27.6 to 26.0. The investigators, Bell and Proctor (230), concluded either that youth is incurably optimistic or that vocational guidance in the schools surveyed was "getting nowhere fast." However, men at the University of Minnesota in 1933 who hoped to enter professions proved appreciably fewer in number and more select in academic aptitude than the group of like intentions four years earlier (399). Wrenn (406) compared the 195 junior college men ranking in the highest 5 percent on the American Council on Education Psychological Examination with the 157 from the lowest 15 percent. The former showed a much greater constancy of vocational objective over a two-year period, and more than twice the percent rating A in the occupation of their choice on the Strong Interest Blank.

5. Clinical Applications

Intelligence in Psychopathology

Abramson (223) found the intelligence of 1,100 unstable children markedly below average, even though the feeble-minded were excluded. The showing was especially poor on group tests and such Binet subtests as the absurdities, fables, and digits backwards. Sullivan and Gahagan (388) obtained a median I.Q. of 92 for 103 epileptic children. Of interest is the observation of Cavalcanti (250) that among fourteen clairvoyants tested, the highest I.Q. was 83. From a digest of the literature, Rouvroy (363) declared that no level of intelligence or degree of deterioration serves to characterize any particular disorder. Duncan (270), however, found among manic-depressives a high association of manic manifestations with mental deficiency, as contrasted with melancholia among the merely dull.

There is accumulating evidence of the superiority of psychotics on verbal as compared with performance tests. Uhler (392) remarked this pattern as distinguishing children referred for serious personality defects and psychotic tendencies whereas among delinquents the reverse order was typical. The Babcock index of deterioration, based on superiority of vocabulary over intelligence in general, likewise continues to receive much attention. Jastak (314) and Simmins (374) found a lower index on the part of hospital patients who later attained discharge; and Chipman (255) noted a high index among the unstable as opposed to stable feeble-minded. Altman and Shakow (226), however, while observing that higher scores in vocabulary characterize schizophrenics in contrast to either delinquent or normal adults, found no correlation between actual size of the index and other criteria of degree of deterioration.

The comparatively good showing on vocabulary in old age seems beyond question. Gilbert (290) observed a large and significant inferiority in mental efficiency by the Babcock test of persons in their sixties as compared with others in their twenties. Moreover, those members of the older group who were regularly employed surpassed the unemployed by the same

criterion (291). This is in keeping with the finding that Minnesota University freshmen were outscored by their older relatives on vocabulary tests, when speed of response was disregarded (256).

Effects of therapy—Landis and Rechetnick (327) detected a distinct improvement in the test scores of paretics following pyrexia treatment. The malaria cure likewise appeared to raise the mental age of these patients, when the latter had not fallen below five or six years (380). Memory proved more difficulty to recover than other functions.

Treatment of 317 mentally defective and retarded children was undertaken by means of a comprehensive remedial program, involving organotherapy, correction of defects, remedial education, and improvement of social environment (295). A gain in I.Q. followed for 45 percent of the endocrine cases, but only 1.2 percent of the 162 others, covering a wide variety of clinical types.

Mentally Handicapped

The characteristics and problems of mentally defective and scholastically retarded children are treated in two recent works by Burt (241, 242), with special attention to corrective procedures. For the mentally deficient, curative measures appear almost negligible, though preventive precautions, both before and after birth, may be rewarding. Among the educationally backward, however, some 40 percent are found suffering from disabilities—physical, psychological, and otherwise—which may be relieved by appropriate treatment with marked benefit to their accomplishment.

Delinquents and Criminals

Intelligence of delinquents—A statistical study by Fenton and Wallace (282) of 1,660 boys and girls referred to the California Bureau of Juvenile Research showed that delinquents and pre-delinquents together constituted the largest single group, and over 27 percent of the total. Except for the mental defectives, those cited for delinquency had the lowest I.Q. of any type of case, averaging 93, as compared with 91 for boys in the Whittier State School. In a midwestern reform school, Charles (252) reported 30 percent of the whites and 48 percent of the Negroes testing below 70 I.Q., as compared with 1.2 and 3.5 percent of boys of the respective races and like age in St. Louis public schools. Moore (342) noted that white boys in the Tennessee state reform school tested significantly lower, even on the non-verbal Myers Mental Measures, than boys in the state orphanage.

Lane and Witty (329) found an equally clear association of low mentality with delinquency, but pointed out that the I.Q.'s of 700 inmates of the St. Charles School were no lower than those of non-delinquents from the racial and social groups from which the majority of these boys were drawn. Moreover, no correlation was discernible between I.Q. and the number of their convictions, age of first arrest, or seriousness of the offense for which

they were committed. The same lack of relationship between intelligence and either age at commitment or type of crime was noted by G. E. Hill (304) in the case of youths in the reformatory at Pontiac. Among this older group, however, the frequent recidivists tested actually somewhat higher than occasional repeaters and first offenders. Finally, a group of psychopathic personalities studied by Michaels and Schilling (340) disclosed no significant correlation between the gravity of their misconduct and performance on either the Porteus Maze or Binet tests.

Language abilities—Two studies serve to supplement the observations reported under "Intelligence in Psychopathology" concerning the relation between vocabulary and other abilities which tends to distinguish the typical delinquent from psychopaths as a group. Glanville (292) noted the marked retardation of language development among industrial school boys in comparison with the level of their general intelligence; and Fendrick and Bond (281) stressed the characteristic deficiency in reading achievement. Among the 187 delinquents examined by the latter, retardation in reading averaged five years and eight months.

Psychiatric analysis—In an unusual approach to the study of causal factors, Healy and Bronner (301) compared over a three-year period, 153 serious delinquents with 145 non-delinquent siblings of near the same age. The delinquents proved only slightly inferior in intelligence to their sibling controls, and did not display any special aptitude for manual tasks. Striking differences in personality and emotional adjustment, however, were revealed, 91 percent of the delinquents giving evidence of extreme unhappiness or other emotional disturbance, as compared with 13 percent of the controls.

Among almost 10,000 consecutive prisoners coming before the Psychiatric Clinic of the New York Court of General Sessions, only 18 percent were classed as mentally defective or definitely psychopathic. The great majority of the remainder, however, were diagnosed as having serious personality defects and disturbances, such as extreme egocentricity, chronic alcoholism, and emotional instability, leaving only 21 percent regarded as normal and adjusted (239).

Speech and Hearing Handicaps

A speech survey of 1,174 school children by Carrell (248) revealed both I.Q.'s and school achievement below average in the 10 percent having speech defects. On the other hand, 87 stutterers located in Pennsylvania State College and the universities of Iowa and Minnesota, showed a median I.Q. of 118 on the Otis S-A Test. This is seven points above the median for 2,500 college students from twenty-one institutions, and equal to the 69th percentile of that distribution. Steer (383) found this in keeping with certain earlier observations, and inferred that selection may operate more rigorously in the case of stammerers.

An interesting study by Hofsommer (307) on somewhat limited numbers disclosed a seemingly marked influence of lip-reading upon I.Q. Among 17 hard-of-hearing children receiving instruction in lip-reading over one to three years, eight recorded a gain in I.Q. and only two a decrease, whereas sixteen refusing such instruction showed twelve declines and no gains.

6. Comment

Few psychologists today look to an individual's score on an intelligence test, alone and of itself, to determine the source of his difficulties or indicate the exact solution to his problems. It is entirely probable, however, that the outcome of such a test, judiciously chosen and competently administered, will contribute as much if not more to sound clinical appraisal than any other single fact obtainable. Properly supplemented with other diagnostic procedures, the information thus derived is virtually indispensable to intelligent attack upon a wide variety of problems. Moreover, its usefulness is increased and the danger of misinterpretation lessened by the steadily growing body of objective findings such as those exemplified in the studies here reviewed.

So extensive is the literature that fresh investigations are scarcely expected to cast important new light upon the relation between performance on our better known intelligence tests and academic achievement, talent, delinquency, dependency, or the like. More promising are those researches in which intelligence is measured as a means to analyzing the influence of various genetic and environmental factors upon mental development and efficiency, or as an aid in selecting subjects or groups for the experimental evaluation of practices in education, industry, social control, or physical and mental therapy. There remains, however, much valuable work to be done in determining the relative merits of different testing instruments for specific purposes and under comparable conditions. Especially is there need for comprehensive syntheses of data from many sources, with the working out of norms and indexes in forms most practically serviceable to the clinician, counselor, and social worker.

CHAPTER V

Vocational Aptitude Tests¹

L. J. O'ROURKE

MORE THAN FIVE HUNDRED STUDIES in the general field of aptitude measurement have been examined in the preparation of this summary. Many significant studies have been omitted because of space limitations.

The discussion roused by the publication in 1934 of Thorndike's *Prediction of Vocational Success* continued into the period under review. Thorndike (529) explained the reasons for certain details of method of his original study, restating his belief that our ideal "should be to be able to make a complete and precise inventory of a boy or girl and to know the predictive value of every item in that inventory, and of all significant combinations of items, for every important purpose of life." An analysis and survey of the general subject of aptitude measurement was published by Bingham (417), who offered suggestions as to the more useful tests in each broad occupational field. The third edition of Laird's book (475) has appeared. In 1936 Kornhauser (470) suggested that in order to advance the utilization of sound test procedure by industrial concerns we should:

1. Concentrate on occupational fields where selective tests can be most clearly useful.
2. Set up competent and economical testing services.
3. Make the testing services known to those who would have use for them.
4. Correct unfavorable attitudes by keeping all test work in competent hands and demonstrating what it can accomplish.

Clerical Aptitudes

Andrew (412) used multiple-factor analysis in studying the Minnesota vocational test for clerical workers, and reported that four relatively independent factors were revealed, viz., academic, clerical, spatial, and dexterity abilities. A committee headed by Dr. Marion A. Bills reached the conclusion that mental alertness tests are better than clerical for selecting clerical workers who do their jobs well and are promotable (439). Uhrbrock (531) also reported on the use of mental alertness tests in selecting clerical employees.

Davidson (438) reported correlations between test scores and promotability, or job level, attained after five or more years of service, as follows: Bureau Test VI, .75; Thurstone, .71; Modified Thurstone, .65; O'Rourke Senior, .77; Minnesota Clerical Numbers, .07; Minnesota Names, .34. Test scores correlate with supervisors' ratings as follows: Bureau Test VI, .41; O'Rourke Senior, .40; Thurstone, .44; Modified Thurstone, .37;

¹ Bibliography for this chapter begins on page 334.

Minnesota Numbers, .27; Minnesota Names, .29. Copeland (436) correlated the Otis Self-Administering Test of Mental Ability and the Minnesota Clerical Test with efficiency and performance ratings for a group of supervisors, clerks, and enumerators. The coefficients of correlation range between .01 and .28. Clarke (431) reported on a battery of tests administered to a group of cashiers (N not stated). Correlations were obtained with the three criteria: (a) actual production as measured by transactions handled per day; (b) supervisors' ratings; and (c) actual error record, as follows: Otis S-A Test of Mental Ability, (a) .003; (b) .25; (c) — .06; amount checking, (a) — .02; (b) .02; (c) .07; change making-time, (a) .23; (b) .06; (c) — .04; change making-errors, (a) .36; (b) .06; (c) .39; dexterity, (a) .31; (b) .39; (c) .10. After weighting the tests by means of a regression equation Clarke found a correlation of .59 between predicted and actual production.

Chase and Darley (427) made a study of age changes and occupational test scores among employed and unemployed female clerical workers, divided into five age groups from twenty to seventy-two years. A battery of occupational tests and the Bernreuter Personality Inventory were administered. Individual differences were found to be more marked than age differences. Levitoff (481) studied the relationship between test scores and the learning of stenography. Two hundred applicants for entry to stenographic training schools were tested, the scores later being compared with efficiency as measured by teachers' ratings and the results of speed tests. Correlations were as follows: general intelligence, .55; memory, .45; attention .44; speed, .20; and manual dexterity, .18.

Moore (496) reported a study at the Westinghouse Electric Company in which an American revision of the National Institute of Industrial Psychology clerical tests was used. After being tested, the clerks were reassigned, the new work being in 90 percent of the cases the type that the worker preferred. The program is reported to have eliminated dissatisfaction and created the general attitude that promotional possibilities depend upon examinations, likes, and aptitudes. It is significant, however, that 90 percent of changes made were promotions.

Correlations between test scores and a work criterion for punchcard operators were reported by the United States Employment Service (533) in a mimeographed study; a substitution test yielded the highest correlations with the criterion.

Mechanical Aptitudes and Manual Ability

Working with 103 boys in a technical school Alexander (409) administered verbal, performance, mechanical, and *G* tests, using measures of achievement in shop work, mechanical drawing, and so forth. The data were submitted to multiple factor analysis and five factors emerged: Spearman's *G*; *V*, the verbal factor previously found by Dr. W. Stephenson; *F*, a practical factor found especially in performance tests; *X*, a temperamental fac-

tor tentatively named "the will to succeed"; and Z, a fifth undefined factor. Factors X and Z seem to be unmeasured by intelligence, performance, or mechanical ability tests. Murphy (501), using verbal and non-verbal intelligence tests and mechanical aptitude tests, concluded that mechanical ability was a combination of a factor calling for speed of hand-eye coordination and a factor dependent on mental manipulation of spatial relations. Langdon (476) reported a two-factor study of simple motor tests with particular reference to practice and diagnosis.

After giving a battery of tests to over 2,000 subjects between thirteen and twenty, Heinis (434: 341-46) concluded that aptitudes mature at the conclusion of physical puberty and the beginning of mental puberty. Similar findings were reported by Messer (489) who gave 1,000 girls bead-threading and wool-knotting tests for selecting dressmakers' apprentices. Scores indicate full development of simple manual dexterities by fifteen and one-half or sixteen years. Ozeretski (504) reported a metric scale for determining the development of motor ability of subjects four to sixteen years of age. The scale shows the total development of the motor level, and provides a profile showing general dynamic coordination, rapidity of movement and of simultaneous movements, and presence or absence of synkinesis.

Frye (450) tested 200 siblings of high-school age with several mechanical aptitude tests, finding the only significant differences between the performances of boys and girls to lie in the Stenquist test, on which boys excelled. Frye found a tendency for both boys and girls to reach their highest efficiency in mechanical test performance at the ages of seventeen and eighteen. With the exception of the spool-packing test B and the Stenquist test, performances of boys and girls between fifteen and eighteen years of age on a battery of motor tests reported by Viteles (434: 737-38) showed no significant sex differences. The Stenquist test yielded low correlations with academic grades when tried on 92 Negro boys (435).

Quasha and Likert (514) made available a multiple-choice form of the Minnesota Paper Form Board Test, the revision being easier to score and having the advantage of objective scoring. Norms for a number of groups, including engineering students, are available. Bingham (419) reported that the MacQuarrie Test for Mechanical Ability correlates .29 with the Scovill Apprentice Scale and .38 with the Otis Higher Examination. Intercorrelations with other tests are given. He concluded that the MacQuarrie test is only a rough indication of the degree to which a person possesses some of the aptitudes desired in mechanical or manual occupations. That women seem to do as well as men in both tests was reported by Philip (506) in a comparison of an electric circuit tracing test with O'Connor Wiggly Block Test (N 471). Correlations of the tests with ratings in field work and laboratory courses (engineering students), and with ratings in practical work, wood-work, and electricity (technical students), ranged from .03 to .38.

Metcalfe and Burr (490) revised and shortened the I. E. R. Girls' Mechanical Assembly Test and published norms for the shortened test. They

eliminated four tests which gave the greatest administrative and scoring difficulties or contributed least to the discriminative value of the test. The median score of yearly age groups showed irregular increase; therefore, the authors offered a table of norms based on mental ages and recommended its use. These norms are of questionable appropriateness. An employer is ordinarily only interested in the skill of the employee relative to the skill of other available girls, not in whether her score is up to the average of other girls of her mental age.

Griffitts (455) studied the relation between anthropometric measures and manual dexterity ($N = 60$). He found little, if any, relationship between scores in mental tests and height, weight, or height/weight ratios. Correlations between test scores and various hand measurements are, with two exceptions, all below .30.

Among the investigators making use of extensive batteries of eighteen and twenty tests are Rupp (434: 177-92), who reported norms for both defectives and normals in tests of mechanical skill and mechanical intelligence; and Piéron (507, 508), who tested 1,461 subjects between twelve and twenty years of age, in developing a scale of technical aptitude. Of a battery of tests given by Biegeleisen (416) to predict success of technical students, tests of information and mathematics proved most significant.

Pritchett (513) reported that men who made high scores on the O'Rourke Mechanical Aptitude and O'Rourke Non-language Tests were, in general, considerably more efficient than workmen making low scores, received more promotions and fewer demotions, and were less frequently laid off. Over 81,000 applicants were examined. Christiaens (429), working with a small group, found that his tests for solderers selected men essentially as their employers rated them. In order to measure *potential* ability, he devised tests involving simple tasks which could gradually be made more difficult and which, on being repeated at twenty-four-hour intervals, would be an example of abridged learning. In a watch factory, a study of the efficacy of finger- and tweezer-dexterity tests was made by Candee and Blum (423); total time on the finger dexterity test was found to correlate .26 with foremen's ratings. Working with eighteen subjects, inspectors at a paper mill found correlations between test scores and output figures to be as follows: dexterity and choice reaction test weighted and combined, .71; dexterity test, .70; tactile discrimination test, .61; choice reaction test, .52; visual acuity test, .23; color discrimination test, .12; speed of perception, —.11 (460).

Subnormals and mechanical aptitude tests—The problem of the vocational placement of subnormals continues to challenge psychologists. Measuring the manual skills and mechanical aptitudes of this group seems a promising line of attack. Pritchard's study (512) of 79 subnormal boys twelve to eighteen years old with mental ages of from eight to fourteen, yielded correlations of .53 to .61 between mechanical ability scores and the criterion—a uniform ship construction task completed by each boy

and rated independently by two judges. Correlations between mental ability and mechanical tests were generally less than .30. Attenborough and Farber (413) however, found a relationship between intelligence and manual dexterity of .58, and between intelligence and mechanical ability of .45. These investigators found evidence that a common factor *G* is measured by tests of verbal and non-verbal intelligence, manual dexterity, and mechanical ability. In the Burckhardt investigation (421), manual functions of feeble-minded children showed a definite slowing down in comparison with normals, and defective coordination was also in evidence.

Frandsen (449) gave the Minnesota mechanical assembly test to 100 boys from 50 to 75 I.Q., finding the average percentile for this group to be 16. McElwee (484) found that among 150 subnormal children, degree of success in performing a construction test seemed to increase with chronological age even though mental age was held virtually constant. Eighteen mentally defective girls skilled in the making of lace were tested by Taft and Kinder (526), who found that no significant relationship existed between ratings of the girls' abilities and their scores on fourteen different performance and non-verbal tests.

Professional Aptitudes

Teaching—Studies of teacher selection will be found in issues of the *Review of Educational Research* dealing with "Teacher Personnel": Vol. VII, No. 3; Vol. IV, No. 3; and Vol. I, No. 2.

Law—The Yale legal aptitude test was used, together with undergraduate grades and intelligence test scores, in an attempt, reported by Husband (462), to predict grades at the University of Wisconsin Law School. The multiple correlation technic yielded a three-variable multiple of .64 which for three-fourths of the cases predicts actual earnings within five points.

Engineering—Bingham (418) pointed out that the young person choosing engineering as a profession should have an accurate picture of his general scholastic ability and his ability to learn mathematics, to think about space relations, to understand mechanics, to master the physical sciences, and to use proper English. The author suggested some of the available tests to be used in making these determinations. A new form board for selecting engineering apprentices was introduced by Oakley (502). Hsiao (461) reported an experiment in testing engineering apprentices in Nanking, in which an extended battery of ten tests was employed; as norms were not available, selection was made on the basis of relative standing in the test scores.

Medicine—An experiment in predicting achievement of dental school students was reported by Harris (458) who found that five mechanical aptitude tests which he administered had only chance correlations with his two criteria, but that the Otis Intelligence Test had a correlation of .552 with first-year average marks. Intelligence and pre-dental scholarship, when combined, gave a multiple correlation coefficient of .670 with dental school

marks. The social and economic backgrounds of students who were accepted and rejected by medical schools were studied by Schaul (519) who listed the factors which seem to characterize the backgrounds of each group. Moss (498) described the predictive value of the aptitude test that is administered annually to more than 9,000 prospective medical students in more than 600 colleges. The aptitude of the physician for specialization in roentgenology was studied by Chantraine (426), who devised a method of measuring the subject's ability to read off, after two-, five-, and ten-minute periods of adaptation, figures of differing degrees of luminosity on a moving cinematograph screen.

Nursing—Clark and South (430) found that of 408 students of nursing those in the two higher intelligence groups, as determined by scores on the Ohio State University psychology examination, tended to evidence a greater dislike for nursing than those in the two lower groups. A Prague study of intelligence and nursing school aptitude showed a correlation of .72 between I.Q.'s and nurse examination scores among students who had been admitted without intelligence tests (434: 374-78). With one exception all subjects with I.Q.'s below 95 failed the examinations. A. P. Johnson (465) gave a battery of tests to two groups of experienced graduate nurses, finding that, in comparison with unselected population, the nurses possessed the following: relatively large vocabularies, either objective or extremely subjective types of personality, high tweezer dexterity, average finger dexterity, high accounting, and low engineering aptitude.

Executive ability—Cleeton and Mason (432) developed a selection instrument for executives which included questions on arithmetic, judgment, a test in non-verbal or symbolic relationships, synonyms and antonyms, a questionnaire, and an interest blank. Their treatment of the general problem included analysis of executive functions and traits and outlines for training procedures. A. P. Johnson (466) found that the higher ranks of executives, irrespective of age, have larger English vocabularies than the unselected population. Since there is a high correlation between vocabulary and general intelligence, these findings may mean merely that executives have higher intelligence. Raphael (434: 175-77) described the technic used to select the managers of British branch banks. The one-hour battery included written tests for (a) accuracy in checking, classifying, etc.; (b) ability to analyze contents of letters; (c) intelligence, framed in banking terms; (d) general knowledge; and (e) social and business tact. No data on validity are as yet reported.

Music—Prediction of success in music has to some extent been treated in earlier numbers of the *Review of Educational Research*, as February 1938, p. 58-59. Studies previously reviewed will not be repeated here.

Kwalwasser (472) inquired into the nature of musical ability, considering the elements which enter into "the complex hierarchy of talents." He found that general intelligence has little or no significant relation to musical intelligence, and that sex differences in music test scores vary according to

countries. European boys scored higher than girls, while in America the reverse is true. An inquiry into the nature of the creative process was undertaken by Patrick (505), who distinguished four stages of creative thinking—preparation, incubation, illumination, and verification. Jacobsen (463) used both non-musical and musical instruments to measure the ability of subjects in dynamic and temporal control.

Farnsworth (446) found that two music capacity tests surpassed intelligence tests as tools of prediction for grades in music courses only when these courses involved tonal perception and performance; for the more academic music courses intelligence tests were better predictors of grades. A new device for measuring pitch discrimination was described by Wyatt (537), who claimed for his instrument an accuracy surpassing that of the phonograph records of Seashore and Kwalwasser-Dykema. The relation of physical characteristics (in this case finger-length and hand-width) to musical ability was studied by Taylor (527), who found that, contrary to popular belief, his pianists' hands were significantly wider than those of the control group ($N = 40$ and 36 , respectively), and that there is a fairly significant difference in the length of the fingers and in the finger-length and hand-width ratio. Among the problems attacked by foreign investigators were: the possibility of determining whether there are children who are inaccessible to music (428), and the degree of ability to adapt to the rhythm of a metronome by children between three and six years (480). In spite of the advanced status of musical aptitude testing Seashore (523) concluded that we have as yet developed no adequate system of guidance for a professional career in music. He warned against any regimentation procedures.

Art—The present status of work in the measurement of artistic abilities is reported in a survey made at the University of Oregon (500), and in a monograph by Kinter (468). The latter stated that ability in the graphic arts is probably more complex than musical aptitude, but that it is possible for the basic factors to be analyzed and measured with the same degree of success as that attending the measurement of musical ability. That artistic aptitude of children is capable of considerable alteration under intensive training was the conclusion reached by Saunders (518) after subjecting artistically inferior and superior children to a two-year program of special instruction and motivation. A new art ability test was developed by Knauer (469) for use in vocational guidance, as teaching material, and as an objective measure of the art ability of a subject in relation to a group. Cane (424) listed the signs, chiefly psychological, by which we discern outstanding artistic aptitude in a child.

Transportation Aptitudes

Automobile and streetcar operating—Progress in the standardization of separate tests in these fields compares favorably with that in other fields (477, 478). Some investigators undertook an elaborate psychophysical

study of the individual; others isolated a single factor of driving ability and attempted to measure that; still others concentrated on detecting proneness to accidents. One of the more extensive batteries is that of DeSilva (440), who used tests for reaction time, steering ability, visual tests, and a general test of road behavior. The visual tests measured color vision, acuity, glare blindness, movement threshold, depth perception, and "tunnel vision." Validation of the tests has yet to be completed, though steering tests correlated well with driving experience, and the author suggested they should form part of the examination for drivers' permits. The National Institute of Industrial Psychology in England also has done considerable work with an extensive battery of tests of reaction time, resistance to distraction, vigilance, vision, visual coordination, judgment of spatial relationships, judgment of relative sizes of near and distant objects, judgment of speeds, and a simulated driving situation test (520).

L. Johnson and Lauer (467) measured performance by right and left hands separately and by both hands, finding that the use of the single hand increases reaction time about 8 percent. B. Lahy (473) found that reaction time is affected markedly by fatigue; Missbach (494) discovered that reactive time may vary from 1.4 to 2 seconds, without any indication of carelessness. Ponzo (434: 284-91) reported that it is just as necessary to measure recovery time as reaction time. Greenshields (454) concentrated on brake-reaction time, while Heinis (434: 234-39), who devised measures of simple and choice reaction times, found that 7 percent of applicants were incapable of learning to drive, and that as many as 60 percent would probably become unsatisfactory drivers! Ability to judge space—its depth and width—is one of the major qualifications of prospective drivers and tramcar operators, according to Drabs (443). He developed a new device, the tachodograph, for measuring this ability.

Variability of performance is the most important symptom of the unfitness of neurotics for driving, according to a series of researches done in Germany by Bena and Mayerhofer (414). Selling (524) is another investigator who included in his battery a "mental hygiene" test. Jekulin (464) divided causes of automobile accidents into four groups and reached the conclusion that the receptor rather than the motor functions should be stressed in training. That alcohol tends to make most drivers drive faster, without their becoming aware of the acceleration, was reported by Vernon (534), and that intelligence tests permit the elimination of the unfit, but do not select drivers of superior ability, was the conclusion of MIs (434: 278-84) in a Prague experiment which showed that a minimum I.Q. of 82 on Army Beta was required for satisfactory driving performance. Váno (434: 293-302) found that 51 percent of the accidents of motormen and bus drivers occurred among the 16 percent of men whose scores were below 60 on Army Alpha. Several other European investigators report interestingly on the use of elaborate psychotechnical methods of selecting streetcar motormen and bus drivers and, in America, Cleeton (433) used an atten-

tion-reaction device to study 700 men for a city street railway system. He also employed tests of intelligence, emotion, and vision, and he stressed the importance of measuring emotional qualities. Mayerhofer (434: 256) used tests of reaction and attention to measure the discrepancy between the task and the available psychophysical energy. Quinan (515), measuring several hundred drivers charged with speeding, found an unusual incidence of left-handedness; he suggested that there is a possible relation between left-eyedness and nervous instability.

Aviation—Aptitude for aviation has received considerable study, chiefly by foreign investigators. The fact that large differences in flying ability exist seems to many investigators to point to the existence of a definite "flying talent" with distinct physiological and psychological components to be measured. Metz (491) in his study stressed the importance of the ability to orient in three-dimensional space which involves, among other things, vision, the vestibular organs, and muscle and pressure senses. Another German investigator, Edelmann (445), would shift the prevailing emphasis in aviation selection technics from physiological to psychological elements, not excluding, however, physical sensitivity measures, such as reaction time.

That the total-personality picture of the prospective air pilot is the most important problem to be studied is the thesis of Gemelli (451), who called attention to nervous and mental fatigue and changes in attentive power and psychomotor reactions during prolonged flying. Pochtarova (510) standardized an interview for aviators; another technic outside the performance category was that by Lottig (482) who developed a writing test for altitude flying. This test consists in writing from six to eight figures correctly spaced in a horizontal line, and in writing numbers in exactly vertical columns. This simple test is claimed to predict with desired accuracy a subject's tendency to air-sickness and the degree of its manifestation. Azoy (434: 203-15) held that the main criteria for selection of aviators are the aptitudes for perception and motor reaction.

Extraverts have a better chance of completing flying training than do introverts, according to McIlnay and Jensen's study (485) of 538 cadets and student officers who entered our army air corps training center. Types of reality adjustment which characterized the students who graduated and those who failed were investigated and the authors reported that it is more important to determine the proportionate energy expended in the mechanisms than their actual degree in the individual. Princigalli (511) worked on the chronaxy test for the measurement of vestibular excitability, using both trained pilots and students as subjects and proceeding on the assumption that practice in flying should have resulted in a labyrinth hypoexcitability. The entrance examinations for Brazilian aviators seem to differentiate three groups—pilots, observers, and administrators—on the basis of scores made in a battery of tests for quick-wittedness, observation, logic, intelligence, control of emotions, and strength of will (420). In Argentina the serious accident rate is reported to have diminished since the establishment

of a psychophysiological laboratory for the examination of military aviators (492). The correlation between scores on the O'Rourke Complex Coordinator for testing American flyers and flying ability are at present being verified on the basis of follow-up studies of later performance.

Railroad occupations—This field has received considerable attention abroad. Among the dozen or more studies reported is that by J. M. Lahy and Korngold (434: 245-55). Psychotechnicians in Germany began in 1917 to test for three different groups of railway employees—shop workers, office employees and ticket sellers, and the technical workers (495).

Miscellaneous Vocational Testing

Accident proneness—High scores in aptitude tests seemed to characterize apprentices who would be comparatively free from industrial accidents, according to a German study by Dombrowsky (442). Left-handedness was found by Grundler (456) to exist somewhat more frequently among accident prone employees than among the accident free employees in iron and steel industries. He also found six tests out of a total of nineteen which differentiated accident prone employees. That intelligence and emotional stability are more important in predicting accident proneness among handlers of freight and general station employees than are tests of motor aptitudes was the conclusion of Lahy and Korngold (434: 140-47), who found that inability to adjust to an unfamiliar rhythm of work caused disorganization of mental and psychomotor reactions. Marbe (486) concluded that while simple tests might successfully differentiate accident prone from accident free school children, such tests will not suffice for industry, because accident proneness in an occupation depends in part on the nature of the occupation.

Employability—One of the emerging trends in aptitude testing has been the measurement of the relation of more or less prolonged idleness to intellectual and work capacities. Gilbert (453) investigated the extent to which increasing age affects the mental alertness of employed and unemployed people. The work of the Adjustment Service in New York City was reported by several investigators including Bergen, Schneider, and Sherman (415), and Dodge (441). Morton (497) gave a battery of tests to unemployed men in Montreal. He found that unemployed relief clients, even with the age factor controlled, were inferior to unemployed non-relief workers, and that inferior test performance tends to be associated with the longer periods of unemployment. Trabue and Dvorak (530) reported an extensive study of the unemployed who registered at the Occupational Analysis Clinic at the University of Minnesota. Rempel (517) classified unemployed adults into four groups on the basis of visual acuity as measured by the Snellen chart. He did not find a significant relationship with various aptitude tests.

Military service—In studies of army and navy aptitudes, foreign workers have directed their efforts toward detecting officer material among recruits (410, 471); selecting the superior artilleryman (488); locating best materials

for specialists in the army (483, 538); and finding the soldier who will make the best foot courier (499).

Occupational groups—Among the Minnesota reports on the use of tests is that by Dvorak (444), whose aim was to differentiate individuals in a given occupational group from the general population and from other occupational groups. Vocational guidance is given by comparing an individual's ability profile with the ability profile of a given occupation expressed in the same terms. Fontegne (448) constructed a vocational profile on which are listed the various aptitudes required for given details of analyzed tasks. Teegarden (528), using a battery of manipulative tests to measure such factors as speed, accuracy, handedness, delicacy of control, ability to follow demonstrations or instruction, and so forth, found that test performance of adults in fourteen men's and sixteen women's occupations show no two occupations presenting identical combinations of test levels on the tests used. Dodge (441) divided 651 clients of the New York City Adjustment Service into thirteen occupational groups, administering four tests and finding considerable overlapping and variability in mean scores. That there is a fairly definite occupational hierarchy based on the level of intelligence of workers in various groups was pointed out by Williamson and Darley (536), who called attention to the discrepancy between vocational choice and level of academic aptitude among Minnesota high-school seniors. All findings with regard to differences in trait averages must be interpreted with due regard for the variability of the trait in any occupation and the overlapping with groups in other occupations.

Police—Mata (487) reported on a comprehensive clinical, physiological, and psychological examination used to select police officers in Europe. Objective measures of emotional stability yielding an "index of imperturbability" form part of the battery. There is a test for details in testimony, as well as tests of practical judgment and critical sense; imagination; simple and discriminative reaction time to visual and auditory stimuli; memory for faces, forms, and colors; rapidity and range of attention; physical measurements; and records of temperament, character, emotional stability, and habits of discipline. Mira (493) found that tests concerning testimony and general intelligence were the most selective out of a battery used in hiring police officers in Spain, and O'Rourke (503) reported on the range and distribution of scores for his Police General Adaptability Test, administered to 2,591 men in nineteen cities for the purpose of establishing standards. A comparison of the test scores and the efficiency of the Washington police force showed that 80 percent of those appointed as a result of the examination are above the average in efficiency.

Salesmen—Giese (452) classified prospective salespeople according to the way they approached and performed the task of arranging a display board of different products. Schultz (521, 522) reported the use of tests of general intelligence, extraversion, ascendance submission, and interests in the selection of life insurance salesmen. He reported the best predictor

to be intelligence if above the 20th percentile; ascendance and extraversion scores were "moderately" successful. Lawe and Raphael (479) announced the finding that "a very high level of intelligence seems to be an actual disadvantage in a female sales assistant." The most comprehensive and thorough study was reported by the U. S. Employment Service (533).

The Need for Improved Criteria

Reports of the predictive value of the same aptitude test range from low to high, and give us little basis for judging the comparative value of tests or even the validity of a single test. An explanation of the criterion and the factors used in it should accompany every report of a test program. When this is done, and when it is possible also to report the reliability of the criterion and to give some idea of its validity, the literature on testing will become more significant. The reporting of a coefficient of correlation between test scores and a superficial criterion is not a contribution to literature; it merely adds so many more pages of confusion. Some reasons for conflicting reports on the relation between efficiency and test scores or other data are:

1. Those who evaluate the tests include different factors in their efficiency ratings for the same class of positions. Correlations between test scores and these different efficiency ratings might well be expected to be different. (a) Sometimes the criterion refers to routine work; at other times it refers to work requiring more judgment. (b) Sometimes the criterion is based upon actual production records; at other times such factors as interest, effort, and personality have a part in it. In the former case, a higher relation should naturally be found between efficiency and scores on carefully constructed tests. If personality, temperament, and other general factors which the test does not measure enter into the total efficiency rating, the correlation will be lowered. For instance, the factors reported as office efficiency by various personnel men differ widely as to the relationships which are reported between test scores and office efficiency. A battery of tests may correlate .24 when a composite criterion including personality, interest, tardiness, and so forth is used, and the same test may correlate .64 when speed, accuracy, or production records alone are used.

2. The factors in efficiency ratings are often given different weights by different raters. The relation between test scores and efficiency ratings will vary according to the weights assigned the factors involved. Some raters will emphasize speed; others, accuracy.

3. Examiners often use tests which, although bearing similar labels, such as "clerical tests," really are quite different owing to the differences in the *range* of the test or in the difficulty at which the test is focused.

4. Some persons construct tests to measure factors that analyses of duties have shown to be important. Others simply go ahead without a thorough analysis of the duties of the position, hoping that with at least some of the tests they will find a significant relation with efficiency.

5. The range of potential and actual ability of the groups tested varies widely.

CHAPTER VI

Personality and Character Measurement¹

GOODWIN WATSON

IT IS AN INTERESTING CHALLENGE to attempt in a few sentences to give the gist of the impression made by a review of several hundred studies of personality and character measurement. No important new approach has emerged during the past three years. The superficial use of self-report questionnaires has continued to be common. There are, however, distinct signs of increasing critical maturity in personality research. Ratings are used with admirable caution. The trend toward molar, organismic conception of the personality as a whole is clearly evident, and is exemplified by the extraordinary attention to the Rorschach test. Some interesting attempts to use factor analysis to discover units of organization more valid than "traits" have not as yet been based upon data obtained through observation which accords closely with the complex and telic organization of human behavior. Very encouraging have been a few studies combining a wide variety of approaches—observational, metrical, clinical, statistical, social, and theoretical—to expand the understanding of one aspect of personality, seen in relation to the rest of the personality and the cultural milieu.

Previous Reviews

The first résumé of personality testing in the *Review of Educational Research* occupied an entire number (June 1932), with 282 references. The résumé in the second cycle (June 1935), consisted of four chapters, and included 416 references.

Maller (702) reviewed character and personality tests for the *Psychological Bulletin* in 1935. Odbert (732) summarized contributions in this area from the 1936 meeting of the American Psychological Association. G. Murphy, L. B. Murphy, and Newcomb (724) have given an extensive critical evaluation of the present status of, and results from, personality testing. Their chapter XIII covers with equal thoroughness the field of social attitudes and their measurement. Stagner (789) summarized findings in experimental studies of personality, while Allport (543) made a major contribution to the literature in English on fundamental concepts of trait, type, and personality. Among the materials in other languages we have noted reviews by Wang (835) in Chinese; by Graf (630) and Biäsch (559) in German; and, more superficially, by Wallon (833) in French.

Some excellent theoretical discussions have appeared indicating, perhaps, the growing scientific maturity of personality study. B. S. Burks (570) criticized the trait concept and suggested that what we want to get at is a deeper and more general determiner of conduct which seems in fact to

¹ Bibliography for this chapter begins on page 340.

make prediction of the intent of behavior more valid than prediction of specific acts. She has suggested the term "nucleus" or "radix" for this underlying coherence in personality structure. Terman (813) indicated that the word "measure" is inappropriate in the absence of true zero points and equality of units. The organismic nature of personality suggests a clinical rather than a test approach. Certainly there is little reason to expect any "statistical shortcut" which will give quick and dependable understanding of personality. Further critical discussion was offered by Cattell (579) and Vernon (830). Reviews of typological theory are presented in Allport's book mentioned above, and in articles by Spearman (783), Bryn (568), Vermeylen (827), and Hořejši (590: 744-47). With the political change in Germany has come a marked decrease in psychological contributions and a tendency to identify typological concepts with racial distinctions. There is not much evidence that typological theories are being taken up seriously or extensively in other cultures.

Self-Report

The most common practice in personality testing at present is to submit a series of questions asking the subject to evaluate his own symptoms and characteristics. Basic criticisms of this sort of instrument have been repeatedly offered. It is well known that a "good" score on a neurotic inventory may be due to deceptive pretense, and may represent distressing maladjustment. It is well known also that subjects are frequently unaware of their own underlying personality characteristics, and may in all honesty vigorously deny those failings which they unconsciously resent in themselves. There are other less serious criticisms which have been made. For example, the questions are often ambiguous; the units of score are by no means equal; and the categories under which responses are grouped are often merely linguistic and arbitrary, with little psychological coherence.

Investigation fairly consistently confirms the low worth of the most widely publicized instruments. Jarvie and Johns (658) tried for several years with improved technics to get counselors who knew students intimately to rate those students on categories of the Bernreuter test. Correlation between these ratings and the test scores ranged from $-.15$ to $.14$ in one student, $.23$ to $.40$ in another, and $-.14$ to $.23$ in the third. "We are led to conclude," they wrote, "that the Bernreuter Personality Inventory offers little aid in the isolation of personality problems." Moran (719) found no differentiation between Thurstone inventory scores for 146 "adjuster" and 41 "known neurotic" students. Hanks (634) tried to predict from autobiographies to questionnaire tallies on "conventionality," "attitudes," and "personality" with no very encouraging results. Landis, Zubin, and Katz (682) matched normal and very abnormal (mental hospital cases) individuals for age, intelligence, schooling, occupation, etc., and found the Bernreuter Personality Inventory and the Page Questionnaire of Schizophrenic Traits both worthless for differentiating the groups. Maller's "Character Sketches"

showed difference in group means, but considerable overlap of individual "scores." According to Benton (557) both normal and abnormal subjects found a substantial proportion of items to be ambiguous. Williams, Kephart, and Houtchens (847) reported that a change in method of administering such a self-report brings substantial reversals in responses and wide variations in scores. This was to be expected. Students in cheerful mood gave a more "dominant" picture, according to W. B. Johnson (661), than did the same subjects on the same blank when they happened to be in a depressed mood. Olson (735), Moore (718), and others showed that anonymity in various degrees alters frankness and scores; but it is unknown how much misrepresentation remains in the anonymous reports. Lentz (689) found reason to believe that not more than 60 percent of the Bernreuter items are reliably marked, with most fluctuation in scores near the mean and on items checked with average frequency. Lorge and others (694) showed that there is more consistency actually in the tendency to answer "Yes" or "No" or "?" to any kind of question in these blanks, than there is to showing the same assumed trait by answering "Yes" to one question and consistently "No" to one of opposite import. Burnham and Crawford (572) carried on a most amusing investigation, using a pair of dice as subject. Ten testings revealed that the dice (i. e., chance scores) were emotionally mal-adjusted, introverted, and (on the Strong Vocational Interest Test) possessed interests like a journalist or a Boy Scout leader.

In spite of such finding the available tests of this type are expanded. Bernreuter (558) prepared a new manual including Flanagan's invention of two scoring scales assumed to be "confidence in oneself" and "sociability," and which, according to his factor analysis, accounted for all the previous four scores. Shlaudemman (775) added another way of tallying the responses which he called an "Idiosyncrasy Scale." Conway (591) made some strips to speed the counting. Shen and Liu (772) made a Chinese version. L. A. Thompson (816) used scales as Laird had done earlier, rather than Yes-No answers. Stefanescu-Goanga, Rosca, and Cupcea (791) made a Roumanian adaptation of Woodworth's psychoneurotic inventory. Bell (555) made a study of home life, health, social relations, and emotional adjustment. Link (693) assembled 150 self-rating items to be checked, and grouped them for scoring about his idea of "extroversion," "aggressiveness," "self-determination," "economic self-determination," and "sex adjustment." He believed, for example, that children who say they like to go to Sunday School thereby demonstrate "extroversion," while those who say they often lose their temper or dislike having others give them advice should be scored as lacking in "extroversion." Dybowski (610) asked university students questions to reveal whether they were "strong-willed" or "weak-willed" in carrying out resolves. Williams and Chamberlain (846) used the Allport Ascendancy-Submission test to study the development of high-school girls, while Stevens and Wonderlic (796) questioned its desirability in employment procedure.

Hildreth (644) and Brown (566, 567) asked questions proper for elementary-school children and Cowan and others (594) worked jointly on a variation of the Thurstone blank for adolescents. Pintner and others (745) made up their set of questions about school, teacher, classmates, self, and family. Symonds and Jackson (811) prepared a set for high-school pupils, adding, as Part II, a section in which students rate their fellows along the lines of May's "Guess Who" technic. Stagner (790) juggled the Bernreuter items a little and came out with symptom counts around the terms "emotionality," "persistence," and two kinds of "introversion." Pintner and Brunschwig (744, 747) modified typical questions to make them more appropriate for the deaf. Willoughby and Morse (851) found that spontaneous reactions made by adults while taking some such personality inventory were of considerable psychological interest. Sex and guilt items most commonly aroused comment. Comparison of the self-revelation offered in the comments with the mark on the paper revealed that the written responses of the subjects frequently gave a false impression.

Results obtained by the use of symptom questionnaires, the validity of which is definitely questionable, are difficult to interpret. Hence Chou's comparison (588) of Chinese versus American students, Pintner and Brunschwig's comparison (746) of deaf children taught by different methods, Myers' study (726) of home factors related to maladjustment in high school, the McCartney and Papurt testing (698) of tractables and intractables in a reformatory, and the comparison by Strecker and others (800) of senior medical students and unselected undergraduates, remain inconclusive.

Closely related to personality questionnaires are a number of inquiry blanks which ask subjects about their emotions and wishes. Landis, Ferrall, and Page (683) queried normal and abnormal subjects about how much fear or anger would be aroused by each of forty situations. Means (711) asked a thousand college women how much afraid they were of snakes, cancer, fire, bulls, and 345 other stimuli. Hildreth and Keller (645) asked secondary-school pupils for their earliest memory, most exciting experience, greatest problem, greatest fear, and most common dream. Apparently no consideration was given to the conditions under which adolescents willingly reveal their inner life. Jacobsen (657) questioned the boys in one school class about their wishes for present and for adult life. Maslow (710) made extensive studies of dominance and found that there may be wide discrepancies between reports of dominance feeling and observed dominance behavior. Huth (655) revised the Bobertag-Hylla test increasing the self-description paragraphs to one hundred. Answers were qualitatively evaluated which reduced to some extent the errors associated with blind-objective-counting of check-marks. Maller (703) put self-description phrases on cards, and children were asked to sort out into boxes labelled "Yes, I am the same," or "No, I am different." This technic, first invented by Hall, relieved slightly the tedium of checking a questionnaire, but did not add

otherwise to validity. Williamson and Darley (849) asked 2,500 students to indicate the frequency with which they enjoy social contacts and initiate social relationships. The mean of a group which had reported active and satisfactory social life on a previous questionnaire was nearly one sigma above the mean of a group previously reporting poor social relationships.

The Humm-Wadsworth Temperament Scale (651, 652) contains 318 items which have been empirically determined to be related to normal, hysteroid, cycloid-manic, cycloid-depressed, schizoid-autistic, schizoid-paranoid, and epileptoid diagnoses. Washburne's Test of Social Judgment (837) contains self-report questions on purposes, social relations, concern for others, emotional stability, and preference for long-term greater rewards rather than immediate lesser rewards. Retest reliability over .90 was reported on a college group, and bi-serial coefficient of .90 showed excellent discrimination between adjusted and maladjusted extremes. One of the most hazardous situations in which to rely upon self-report would seem to be with prisoners in an attempt to determine which are worthy of parole, but Laune (687) is trying out a questionnaire containing "Yes"- "No" items related to success on parole.

A classical attempt to disguise the purpose of the inquiry so that subjects might not easily influence their scores was the Pressey X-O. Durea (607) studied items checked by delinquent as compared with non-delinquent boys, and found the delinquents were more worried over "death," and "sin," more attracted by "movie star," "joy riding," "tap dancing," and "candy," and more apt to admire wealthy, handsome, and well-dressed people. Symonds (808, 810) asked adolescents and adults to rank suggested interests and problems in order of importance. Men rated higher interests in health, safety, money, and success; women gave higher rating to personal attractiveness, manners, home and family relationships. The low rating given to sex should probably be interpreted not as evidence of its unimportance, but as further evidence for the distortion of self-report by inadequate self-understanding and by desire to give a conventionally favorable impression. Differences in maturity between girls of the same chronological age before and after first menstruation were studied by Stone and Barker (799) who made use of several measures. The Bernreuter test did not reveal differences but the Pressey Interest Attitudes Test and the Sullivan Scale for Measuring Developmental Age in Girls showed the psychological maturity which accompanies endocrine changes.

Mira's confidential questionnaire concerning affective memories, life-attitudes, inferiority feeling, methods of dominating, sense of guilt, etc., has been worked out with considerable characterological insight. The questionnaire was given by Alier i Gómez (542) to 337 Spanish subjects. He recommended taking account not only of answers but of attitude toward the questions. Wolff (855) made a more intensive study of twenty-five children and twenty-four young people who consulted the Psychotechnic Institute for vocational guidance, but the number of cases would hardly

justify his generalizations about age and sex differences. Stavěl (590: 378-85) suggested to the Eighth International Conference on Psychotechnics a standard procedure to include: (a) graphological analysis; (b) questionnaires based on Jungian types, Kretschmerian types, and psychoneurotic symptoms and interests; (c) personal history; (d) observation and diagnoses of behavior; and (e) interview with the subject. The interview is believed likely to be much more rewarding after these preliminary examinations.

Euphoria—Satisfaction and Happiness

One of the chief objectives of education and of social organization is personal happiness. This important aspect of life cannot be measured externally because of the poor correspondence between inner feeling and the impression one succeeds in making upon others (636). Self-report must be used; hence this measure, like those preceding, is in considerable degree dependent upon the achievement of satisfactory rapport. It is probable that reports of unhappiness are less contaminated with pretense than are reports of happiness.

Some investigators have asked directly about general state of happiness. Symonds (809) used a seven-point rating scale, and found the happy students more concerned with affairs outside their own personal problems. (So science accords with the philosophy expressed in the New Testament!) Chant and Myers (583) used the Thurstone scaling procedure on twenty-two statements ranging from extreme depression to extreme elation. Distribution among normals was skewed toward the euphoric end; the cyclic patients were distributed in a U curve, schizophrenics were more unhappy than is sometimes assumed. Young (862, 863) found that college students rated their mood as cheerful five times as often as depressed, with laughter occurring many times a day and weeping only about once in three weeks. Barry and Bousfield (547, 564) asked subjects to rate euphoria on a scale of ten categories and compared results with the number of pleasant versus unpleasant associations the subject could produce. They found the two measures in substantial agreement. Women seemed happier than men, a finding which the authors relate to the fact that women reported an average of an hour more of sleep per twenty-four-hour day.

Hoppock (647, 648) studied job satisfaction among all the inhabitants of a Pennsylvania town and found that a large majority enjoyed their work. A second study based on industrial psychologists showed that they were closely comparable to other professional and executive employees. Apparently their psychological understanding had not produced greater success in obtaining satisfaction; neither had it made them unusually morbid or depressed.

Burgess and Cottrell (569) and Terman and Bottenweiser (814) devised questionnaires, the items of which could be scored to measure satisfaction

in marital adjustment. No relation was found between happiness and age at marriage, differences in age, or number of children.

Boder and Beach (562) secured information of special value to educators. Adolescents were asked to answer anonymously what government, parents, school, or church might do to increase the happiness of young people. Most demands were made upon the school. Of the demands upon the church, half were for recreational features.

Crook (596) presented to students Dunlap's dilemma: "If the only alternatives for your future were: (1) living your life over exactly as it had been lived, with no knowledge of your future as you went along, or (2) being painlessly and permanently extinguished, which would you choose?" About 14 percent of 220 white students and 21 percent of 107 Negro students chose extinction. When the dilemma was rephrased to include only the past two years, the percents were respectively 11 and 19. Differences between men and women students were not significant.

Interests

Questionnaires concerning interests also rely upon self-report, but under ordinary circumstances subjects are apt to be able and willing to report their conscious interests. Limited experience, of course, may make it impossible for a subject to know whether or not he would like a given activity if he tried it.

A basic study of interests was made by Thorndike (817, 818, 819). The evidence showed that individuals believe that they have changed surprisingly little in interests between the ages of twenty and fifty. An important fact in interest measurement (like the observation reported above by Lorge on the Bernreuter) is that people have somewhat consistent tendencies to check L (Like) or D (Dislike). This general trend toward positive or negative report may have to be taken into account in interpreting any given interest. Weedon (838), in a dissertation, reviewed interest measures and raised fundamental questions concerning the observation and interpretation of behavior to indicate interests.

Most famous of interest tests has been the Strong Test of Vocational Interests. During the period under review a Vocational Interest Blank for Women has been published (803). Young and Estabrooks (860, 861) developed a scoring scale to use the Strong test as an index of studiousness (i. e., factors other than intelligence making for high academic grades). It, however, showed an average correlation of only .35 with scholastic standing. Williamson (848) and Mosier (722) found the studiousness scale of some slight value in arts colleges, but of less predictive value than high-school scholarship, and of no value in technical or business schools. Newbury (728) selected items from the Strong and Miner tests to predict grades in a psychology course. Strong (802, 804) has compared interest responses of men and women and derived therefrom a masculinity-femininity score. Kelly, Miles, and Terman (665) found that subjects instructed to

be as masculine or as feminine as possible could at will produce very great shifts in score.

Interests of children were tested by pictures of play materials (826) and of men performing various types of work (628). Lehman and Witty (688) gave their questionnaire on occupational interests to nearly 27,000 boys and girls. Stability of vocational interest among children aged eleven to fourteen was checked by Lahy (590: 356-63). Baumgarten used the familiar method which requires children to select book titles which would interest them most. Her findings were published in various European publications (549, 550, 551, 590: 323-28).

Inventories for the guidance of youth in matters of education, health, recreation, civic functions, and vocation have been standardized by Kefauver and others (664). Williamson and Darley (850) compared vocational choices of high-school students in Minnesota over the period 1929-33, showing, during that period, some decrease in choice of engineering and increase in agriculture, forestry, and skilled trades. The concentration upon a few choices evidences our continued failure to give youth a good knowledge of occupations. Neubauer (590: 446-52) reported at the Prague Conference on Psychotechnics inquiries into occupational preferences of students in high schools, while Baumgarten and Zürcher (590: 393-99), Seracky (770), and Grawitz, Laugier, and Weinberg (631) questioned youth with unflagging curiosity, not only about occupations but also about pleasures, reforms, life aims, life philosophy, emotional problems, tastes, etc. Reading interests were appraised by Altstetter (544) who found that teachers are believed not to have played a major role in influencing reading choices, and by Morgan and Leahy (721) who signed "culture" weights to current magazines.

Opinions and Attitudes

The validity of attitude scales depends in part upon the achievement of clarity in the test, and in part upon rapport with the examiner. Only rarely does a report upon attitude testing use sufficient care to describe the situation and the way a relationship was built up within which trustworthy responses might be expected.

Concepts used in attitude measurement have been criticized and defined by Kulp (681) and Kirkpatrick (671). A general discussion in Chinese, based on Thurstone's scales, was prepared by Wang (834).

One development in attitude scales, mentioned in the June 1935 issue of the *Review of Educational Research* and continuing since, has been the use of a generalized or "master" scale which can be applied to any of a class of objects (755). One number (756) of the *Purdue University Studies in Higher Education* presented scales for measuring attitudes toward any institution, for example, war, communism, marriage, Sunday observance; another scale for measuring attitude toward any defined groups of people; another for attitudes toward any homemaking activity; another toward any

social or personal practice, such as drinking or petting; another toward any occupation or any school subject. A second series of studies (754) appeared in 1936 reporting student attitudes toward basic freshman studies; presenting rather unconvincing evidence on the validity of the Miller scale for attitude toward vocations; surveying attitudes toward recent economic policies (the subjects favored a gold standard, old age pensions, and a thirty-hour week!); measuring appreciation of poetry in accord with professors of literature; describing a scale for measuring attitude toward any teacher, and another for attitude of audience toward any play; and a three-axial scale to show approval of the objectives, organizations, and personal participations related to any social activity. Whisler and Remmers (842) in another article described a scale for group or personal morale.

Attitude tests used during the 1935-37 period were classified as to subject. The largest group reported in psychological journals dealt with attitudes in the relationships of children and adults. The extensive use of attitude tests for parent education and teacher rating represents a useful cross-fertilization of scale construction with another phase of applied psychology. Koch and others (678) used the Thurstone scaling technic to measure attitude concerning the amount of freedom children ought to have. Stogdill (798) found psychologists approving more freedom, and parents less, with students intermediate. Ellis and Miller (613) revised Wickman's scale and technic and obtained a higher correlation between teacher judgment and mental hygienists. Fitz-Simons (617) developed a guide for scoring case studies in terms of parent-child relationships. Ackerley and others (540) found attitude scales in agreement with findings from personal interviews. Duplicate and disguised questions were used to check on present practices. Hedrick (639) used the Ojemann scale (733) to measure attitudes toward self-reliance in children among a group of parents before and after six weeks of training. The effect appeared to have spread beyond the confines of subjectmatter covered in instruction. Stogdill (797) summarized twenty-eight studies of the attitudes of adults toward children which appeared during the first generation of the twentieth century. A particularly helpful use of tests and questionnaires for educational purposes was Butler's study (573) of 1,586 high-school pupils to discover what they knew and believed about family relationships and child development.

Several investigators have been concerned with children's attitude toward parents. Stagner and Drought (788) developed a scale, using the Thurstone technic, which accorded with self-ratings and biographical sketches. The article lapses at one point into the questionable assertion that since there is a positive correlation of .17 between attitude toward father and attitude toward mother, and since no difference appears between men and women in this respect, therefore the Freudian theory of the Oedipus complex is incorrect. It is unfortunate that studies which presume a disagreement with psychoanalysis so often attack a position which no Freudian would try to

defend. Meltzer (713) obtained more relevant data by asking 150 children to think out loud ten free associations following each stimulus word. "Father" and "mother" occurred in the list. The results were analyzed as well as counted. DuVall (608) used Bogardus' Social Distance technic to study closeness of children to their parents. Well-adjusted children were, as would be anticipated, closer to both parents. M. Simpson (778) did an especially thorough and penetrating analysis of parent preference among young children. She used direct questions, questions about pictures, about stories, and about dreams. All sex and age groups except five-year-old girls showed more mother-preference. Peterson (754: 127-44) correlated attitudes held by parents and children on current social questions. The greatest resemblance was found within the same generation, for example, parent with parent or sib with sib. Again the greater influence of the mother was shown. Mott (723) used three questions from the Rogers test to study mother-father preference in children, finding that both sexes preferred the mother but, of the minority, more girls than boys rated father ahead of mother.

Attitude toward loved ones was explored by Mangus (705), who asked 700 college women to rate their fathers, boy-friends, and ideal mates. Ideal mates resembled boy-friends more than fathers which, according to the author, militates against an Elektra complex. Apparently Mangus did not take into account the age of father and attitudes of child when the Elektra complex is formed, or allow for the obvious fact that boy-friends resemble mate-ideals in age characteristics.

Attitude testing has recently become a commercial enterprise. The Gallup poll is supported by weekly reports featured in more than seventy newspapers. *Fortune* has aroused considerable interest with its "Quarterly Poll of Public Opinion." During the period of this review a large number of straw-votes and opinion measures attempted to predict the 1936 presidential election. The ignominious failure of the immense *Literary Digest* poll, which had for so long been phenomenally correct, emphasized the distorting effect of a sampling error. Public opinion polls since that time have been more concerned with the representativeness of the sample than with large numbers of votes collected by a procedure which may involve constant errors.

Stagner (786) emphasized another important technical consideration in his studies of Fascist attitudes. People who strongly disapproved of Nazi Germany or Fascist Italy often unwittingly shared many of the basic Fascist beliefs. Koeninger (679) reported that consistency of "radical," "liberal," or "conservative" attitudes was rare among high-school seniors. Lentz and others (690) published a C-R opinionaire to study conservatism-radicalism among college students. The test can also be scored to show deviation from majority responses, or what Lentz calls "minority-mindedness." Maller and Tuttle (704) developed a test on contemporary social problems, including sections on probable consequences, beliefs accepted

or rejected, news items of social policy, pleasant and unpleasant suggestions, selection of vital factors in civilization, and attitude on certain problems and toward certain groups. Data from four colleges (820, 821) indicated that the more socially-minded students read progressive magazines, worked their way through college, were active on projects off the campus, and took courses with liberal teachers.

Attitudes toward persons of other races were studied by the Bogardus Social Distance technic and checked against personal interviews with fifteen children. Zeligs and Hendrickson (864) found 87 percent agreement between test and interviews. Dodd (604) used a good combination of scaling technics. General statements of attitude ranging from friendly to hostile were first scaled by the Thurstone procedure and five were selected. These five were then applied as a social distance measure to fifteen national groups, eleven religious groups, and eight other groupings. Zeligs (865) asked sixth-grade children to write the most interesting true sentence they could think of about each of thirty-eight national or racial groups, thus revealing popular stereotypes. Horowitz (649) studied attitudes of children from kindergarten through eighth grade in three radically different cultures, with results which illustrate exceptionally well the way in which race attitudes are taken over from the social environment. Rosander (759), through a scale of attitude toward the Negro using statements describing behavior rather than opinion, maintained that although behavior description scales and opinion scales agree closely, the former gives a clearer, sharper picture of the individual reactions. Davis (600) studied attitudes of 232 Negro students toward Negro traits, Negro militancy, and Negro occupations. Baumgartner (552) followed Likert's technic of building a scale to measure the racial self-respect of the Negro.

Several investigators have used scales to measure religious attitudes. Wilson (852) asked subjects to rate the extent to which influence of relatives, reading, voluntary service, seasons, solar system, plants, animals, and other factors may have been religiously helpful or harmful. Franzblau (620) found Jewish children who accepted religious beliefs to be less intelligent and less adequate in character. A "Religious Ideas Test" was developed for his study. Woolston's questionnaire (856) covered theological beliefs, religious practices, and cooperation between religious sects. Sturges (806) drew up a similar questionnaire on beliefs (orthodoxy) and practices (piety). Individual scores for orthodoxy showed a correlation of about .5 with piety. Kirkpatrick and Stone (670) evolved a scale of seventy statements to appraise religious attitudes of educated groups. Both Kirkpatrick and Woolston found parents to be more religious than offspring. Binnewies (560) submitted to students questionnaires on God, prayer, the Bible, Jesus, creation, and immortality, and found the more advanced students to be the least orthodox. Cristescu (595), under the auspices of the Roumanian Social Institute, formulated a questionnaire on magical beliefs and practices to use in connection with a comprehensive survey of village life.

Two scales for militarism-pacifism were reported. Miller (715) criticized the Peterson-Thurstone scale because, he claims, most subjects check items which range over a considerable portion of the scale. Zubin and Gristle (866) developed another scale which reliably distinguished R.O.T.C. from pacifist society members. Interesting evidence of the need for taking social influences into account has become apparent with changes of recent months in attitudes toward war. Subjects who, two or three years ago, scored alike in pacifism might well be far apart today because the groups (e. g., Fellowship of Reconciliation vs. Communist Party) in which individuals belong have moved in different directions. The determinants of attitude are apparently better sought in social organizations and alignments than in the variables age, I.Q., college class, etc., so often correlated with score.

Among the miscellaneous attitude scales reported during the period of review we note attitude toward: nursery schools (597); high-school discipline (754: 214-24); feminism (672, 673, 674); relief (741); employers (822); and criminal or other offenses (779, 843). Taylor (754: 192-202) studied attitudes of Negro pupils toward high-school subjects and teachers. Rundquist and Sletto (762) published their Minnesota Scale for the Survey of Opinions which ranges over a variety of subjects almost as heterogeneous as the present chapter. Attitudes toward personal adequacy, family, law, the economic system, education, and life in general are recorded. More comprehensive, but less objective, was the questionnaire used by Pintiliescu (743) to study attitudes of coeds in Roumania toward education, professors, fraternities, vocations, feminism, politics, religion, and family life.

In some of the studies, the center of interest was in the effect of some factor upon attitudes; the scale was only incidental. Thus, Manske (706) found some evidence that ten "non-indoctrinating" lessons did influence pupils in a generally liberal direction, while the two statistically significant changes were both in the direction of the teacher's own attitude. Peregrine (754: 55-69) found that printed material favorable to the Negro brought favorable change which persisted for at least two months. Remmers and Morgan (754: 109-14) used an anti-Nazi story which did not change attitudes, perhaps because the meaning of the story was not clear. Chen (585) followed up his study of propaganda concerning Manchuria and found that the influence of a fifteen-minute talk died out in five to six months. Wilke (845) compared direct speech, speech over a loudspeaker, and printed material, and found their degree of effect to be in that order. As usual, the radical attitudes proved more stable. College study liberalized attitudes as measured by the Manley Harper test, but particularly for students who pursued certain courses (563). College tended to make the students tested by Telford (812) more lenient in demands for punishment of criminals. Bateman and Remmers (754: 27-51) found it possible to shift high-school students by prepared instructional material, to favor social

insurance, capital punishment, and the condemnation of labor unions. Just why this set of social objectives was chosen is not explained; presumably it illustrates the lack of rapport so often found between psychological experimenters and educators. McConnell (754: 70-104) on the other hand, built his attitude test around educational objectives designed to help children act more effectively in dealing with four rural social problems.

Hay (638) used an attitude scale before and after a debate which showed little residual change. This kind of finding illustrates a serious defect in most attitude testing. If the positions tested are thought of as lying on a horizontal scale from left to right, there is needed some measure along a perpendicular scale to distinguish "depth" of attitude. Two persons checking the same point on a horizontal scale may be quite unlike in superficiality versus profound concern. Hay's audience after the debate may well have changed on a scale of concern in and knowledge about the issue, although not in average favorableness to one or the other side. According to Remmers (754: 105-108) "significant" change after a half-hour address on the League of Nations might have been interpreted, if a "perpendicular" scale had also been used, as due to a fairly ignorant, superficial, and "don't care" status of attitude both before and after the talk. It is obviously easier to induce change in an attitude which does not have much depth. Another Purdue study by F. Peters and M. R. Peters (754: 15-26) showed a better attitude toward law in a school with pupil participation in government. An interesting social observation was made by Whisler and Remmers (841) following the 1936 presidential election. We recognize that attitudes influence an election but apparently elections also influence attitudes. The winner was more popular after winning; the loser lost some of his former favor. Lorge (695) studied what might be called "susceptibility to prestige influence." Subjects rated famous persons, rated quotations with no names attached, and then in a third test rated the same quotations attributed (truly or falsely) to some of the names. They found that high regard for the source of a quotation raised its value in the eyes of the student. Here again if a "depth" measure were used, important differences might appear. Sherif (773) asked subjects to rate short literary passages and found, as did Lorge, that when ascribed to an approved author, the standing of the passage was raised.

Reputation, Rating

The reviewer is impressed with the observation that although ratings are frequently made the basis for personality evaluation, a generation of criticism has made psychologists careful and critical in their use of such measures. How long will it take, we wonder, before teachers, employers, and other persons less psychologically sophisticated will appreciate the limitations of the marks, grades, and ratings still so readily assigned in practice? Arge-lander (545) summarized some of the ways in which personality is misrepresented by ratings. Smeltzer and Adams (541, 781) compared the

technic of narrative summaries with that of a graphic rating scale and found much less reliability for judgments based on the narratives. This appears to be due to the greater complexity of the narrative account, and it may be that the simple check on a graphic scale, while more reliable, is less valid. Sears (769) presented some evidence that persons who lack insight (i. e., whose self-ratings do not agree with ratings of him by others) also tend to project their trait characteristics onto others whom they rated. Wolf and Murray (854) investigated the records of five judges who had worked together for two years. They have presented an excellent set of principles which they followed in order to make their work more accurate.

Ratings often play a part in college admission. Hartson (637) reviewed over a thousand cases and found the ratings on intelligence and methods of work most highly correlated with Oberlin scholarship. Ratings by principals were most valid. Bent (556) found that rating of student teachers by judges in conference gave scores which correlated more highly with other tests than did averages of the same number of ratings made individually. Page (737) found ratings on "leadership" at West Point highly correlated with "bearing and appearance" but not closely related to academic standing, which may be a reflection on the academic marks or on the military standard of leadership.

Ratings of school children have been reported on Baker's Detroit Scale (546), a "Guess Who" questionnaire (700) and the Winnetka Scale for Rating School Behavior and Attitudes (824, 825). Olson (734) found that asking teachers to name the boys and girls causing most trouble located only about half the children who fall in the worst 10 percent by the Haggerty-Olson-Wickman Scale. The state department of public instruction of Michigan (714) prepared another scale for recording behavior of elementary- and secondary-school pupils. Doll and his associates (601, 602) in more than a dozen articles of which we list only two, described the Vineland Social Maturity Scale, consisting of 117 items related to increasing social competence from birth to adult independence. Although these are ratings rather than tests, an age-level arrangement like the Stanford-Binet has been followed. Results obtained from two informants usually differ by less than half a year.

"Adjustment" of children who had been studied in a child guidance clinic was estimated by parents, clinicians, and teachers. Carberry (575) found that all three judgments were necessary to make a comprehensive picture. Davidson (599) found that good adjustment was more likely with children under fifteen years of age, normal or above in intelligence, with school placement corresponding to mental age.

A major factor in personality adjustment is acceptability among one's fellows. Moreno fostered extensive analysis of social relationships, finding that delinquents placed in congenial groups make markedly better adjustment in many ways. A new journal entitled *Sociometry* is now being published to foster particularly sociometric studies. Lundberg and Lawsing

(696) made a house-to-house canvas of a Vermont village and obtained the names of closest friends. "Isolates" (not chosen by anyone), "stars" (chosen by many "satellites"), "pairs," "chains," and other social relationships were identified. An interesting incidental observation showed a tendency to name, as friends, individuals of higher socio-economic status.

Friendships among adolescent boys were studied by Pellettieri (742) with an "information finder," with the usual emphasis upon similarity in age, proximity of homes, attendance at the same school, and interparental friendship. F. W. Burks (571) found that the George Washington University Social Intelligence Test still shows the same lack of agreement it has demonstrated for years with sorority-sister ratings on social qualities. Soderquist (782) found ratings by associates to be reliable and valid measures of sociability among high-school students. Newstetter (729) checked choice of preferred association on a ballot with actual compresence as recorded by observers in a camp, and found a mean correlation of .73 between the two measures. An especially important observation was that the best liked boys of the group were those to whom others were cordial, not necessarily those who were cordial to their associates.

Objective Tests

There continue to be many lines of approach to the objective measurement of personality—physiological, perceptual, intellectual, and the recording of behavior in controlled situations. Progress along this line has been slow, accompanied by the development of a few new concepts such as perseveration and level of aspiration.

Physiological measures are usually disappointing in their correlation with complex behavior syndromes. G. N. Thompson (815) found blood-type unrelated to intelligence, introversion, or Pressey X-O scores. Omwake and her associates (736) found little relation between metabolism, blood pressure, and temperature, and intelligence, scholarship, activities, or Bernreuter scores. Hamilton and Shock (633) studied the acid-base balance of the body and found no large or consistent relationships, but some tendency for a correlation between instability and sub-breathing. They suggested that the physiological correlates, where found, may be result rather than cause of personality deviations. Gilkinson (629) reported that pitch-level of speaking voice showed a correlation of .3 or .4 with ratings and interests indicating masculinity, but hair distribution and skeletal proportions were unrelated to psychological masculinity.

Five studies used Luria's technic which involves voluntary hand movement coordinated with speech response to a stimulus word. J. W. Gardner (625) found words of sexual connotation differentiated by longer reaction time and more intense deflections in the record of the preferred hand preceding and following the required response. Speer (784) checked motor responses to items from a symptom questionnaire. Runkel (763) perpetrated an exciting incident and found critical words identified by verbal

responses in one-half of the cases. Houtchens (650) found a bi-modal distribution of scores for delinquents on delayed response, unusual response, voluntary motor response disturbed, and involuntary movement. Ebaugh (611) reported the graphic record useful in both diagnosis and treatment of some psychiatric problems. Yarmolenko (859) studied the precision of hand movements among normal and neurotic children, finding that the largest differences occurred in rather static situations. In psychoneurotics as contrasted with cases of organic disease, active response helped to bring better coordination. Langer's tremograph may prove helpful in further studies of the relation of motor disorganization to personality (685).

Lie detectors have been more popular in the press than in scientific literature during the triennium. Winter (853) found a cardio-pneumopsychograph more reliable than verbal indicators in an association test applied to suspected thieves in a college dormitory, but recommended a combination of both types of measure. Just why Chant and Salter (584) supposed, in defiance of the long and impressive record, that the galvanic skin reflex would indicate the emotional nature of an attitude, they do not explain.

Free association continues to be an interesting method for the exploration of personality, although there may be some doubt about its use as a "measure." A. P. Johnson (660) standardized a new form of the Kent-Rosanoff test, intended to be comparable in results to the original. Laslett (686) has defended against criticisms his use of free association methods to differentiate delinquents. Carington (576) found that the association reaction time of mediums in the trance state was negatively correlated with the reaction time to the same words in normal state. This suggests the complementary nature of the trance personality. Siebert (776) showed how subjects who had recently been thinking of some emotional conflict tended to be influenced by it when giving free associations to a "neutral" word.

From the Spearman school, studies of perseveration persist. Stephenson (792, 793) introduced the *p* factor in both British and American journals as the best available character tests. Cattell (580, 581, 582) improved the tests, eliminating any correlation with *g* among persons over ten years of age. A machine called a "perseverameter" may be used; paper-and-pencil tests which involve alternation of similar tasks are more common. A given test is valid only for its first application. Scores for *p* decline with age for adolescence, then rise to a stable adult score with no sex differences. Fatigue and conflict increase *p* score. Both extremely high and extremely low *p* scores seem to indicate inferiority of character (low *w*), and are common among delinquents and neurotics. After treatment and readjustment scores changed to moderate levels.

Everall's study (614) of perseveration in rats suggested a clinical interpretation of the tests. Apparently adaptive behavior regresses to perseverative if the adaptive efforts suffer too much obstruction.

Perseverance was measured by Clark (589), who used word-building

and number-building tasks, and also by Dorcus (605) in repetitive tasks, drawing a line slowly and solving puzzles. Clark found correlations with ratings which challenge the doctrine of specificity but Dorcus could find little agreement among the several tests. It should perhaps be noted that in this triennium no studies which used the old, pioneer Will-Temperament Test, devised by June Downey, came to our attention.

Studman (805) continued a study of psychotics begun by Stephenson and Simmons, and found in addition to *g*, *p*, and *w*, a fluency factor, *f*, associated with elation, talkativeness, self-confidence, and excitability. Dybowski (609) found tests of perseveration correlated with ratings on negativism among adolescent girls. Kremm (680) compared a few city and country dwellers on ability to divide attention between two tasks, and to alternate from one task to another.

Threshold of perception varies with the situation but may also indicate a personality factor. Bartlett (548) checked Travis' finding on changes in auditory threshold during reverie, but with contradictory conclusions. According to Bartlett, dementia praecox cases showed less change during reverie than did normal and psychoneurotic groups. Dahms and Jenness (598) agreed with Bartlett on the unreliability of threshold changes. A test of response to verbal suggestions on arm movement was more reliable but not related to the threshold changes. McDougall's theory of introversion and extraversion as related to shifts in perception of a reversible figure was further studied by George (627) who checked the laboratory tests against a rating scale devised to eliminate the common correlation of extraversion with dominance and ascendance. Rau (752) used perceptual tests to classify racial groups (only 81 subjects altogether) in accord with Jaensch's typology. Masaki and Otomi (709) observed the effect upon work of constant interruptions or of rejection of choices which the subject believed correct, and pointed to possible value for typology.

Surprisingly few tests of the moral knowledge type have come to our attention during the period of review. Kinter-Remmlein (669) used an adaptation of the moral knowledge and also the conduct tests of the Character Education Inquiry with 100 children in Paris. The French children performed best on moral knowledge, prediction of consequences, and co-operative behavior. Ackerley (539) used information items as well as attitude questions in testing understanding of child development by parents of elementary-school children. One section of the Moss Social Intelligence Test which deals with judgment in social situations was revised by O'Connor and others (731).

The change to life-centered objectives and more progressive methods in many schools has brought achievement testing closer to personality measurement. Wrightstone (858) in his battery for appraising results of social studies teaching, included tests of ability to interpret data, to apply generalizations, to organize facts, and to judge civic beliefs and attitudes. Noll (730) devised items for measuring accuracy, intellectual honesty,

open-mindedness, suspended judgment, insight into cause and effect, and self-criticism, all of which was summed up as the "scientific attitude." Peatman and Greenspan (739, 740) reported an instrument for measuring superstitious belief among elementary-school children.

Ordinary objective tests of school achievement may reflect certain personality traits. Wiley and Trimble (844) asked students to indicate doubt or certainty on items, and suggested that this measures some characteristic of the individual. Hertzman (643) studied confidence ratings in connection with memory for names and photographs. Cheating on classroom tests has been used as a measure of dishonesty by a half-dozen investigators (593, 616, 717, 774). Corey (592) found no correlation between verbal expressions of attitude about cheating and the amount of actual cheating done during self-grading of test papers. Parr (738) and Carlson (577) analyzed the conditions of pressure and classroom morale under which cheating is most apt to arise. Teachers more sensitive to behavior problems and apt to use marks for motivation reduced the amount of cheating.

Other studies of honesty were made by Wrightstone (857) using Maller's self-marking test, on which progressive schools showed up as more honest than traditional disciplined schools, and by Ruzicka (765) who improved on Zillig's experiments described in our review of 1932. Maller (701) included his self-scoring test, along with measures of association, self-report of symptoms, and ethical judgment in a "CASE Inventory" with two comparable forms adapted to persons in fifth grade or beyond.

Lewin's concept of "level of aspiration" was found by Frank (619) to be consistent for the same individual in three different tests. Meerovitch and Kandaratzkaya (712) compared level of aspiration in hysterical, normal, and organic-lesion children. Another Russian report (768) used rate of satiation at simple tasks as a measure of personality, and found mental defectives less tolerant of monotony.

Factor Analysis

Stephenson (794) defined "psychometry" as concerned with measurements of single traits in a large population, and "type psychology" as concerned with the measurement of a population of traits within a single person. The interrelations of the traits have been explored in several studies by the use of the statistical technic called "factor analysis." Rexroad (757) secured ratings of 850 students on ten selected traits, and analyzed results by the centroid method. The first factor was heavily present (.69 to .85) in all the traits and seemed to be an approximation to a faculty ideal of what a student should be. A second factor was plus in class but minus in social life outside. Loadings with third and fourth were slight. Chi (586) analyzed ratings on pupils in the elementary school at the University of Chicago, and found evidence for consistent differences in point of view of different raters, persistent halo effect, a general factor (w ?) and specific factors for each trait. The general factor presumably accounted for about

one-third of the variance, the specific factor for about half. McCloy (699) analyzed ratings of forty-three traits in a population of thirty-one students and named the four major factors "social qualities, dominance, individual qualities, and positive attitudes."

Two studies reported tests instead of ratings as a basis for factor study. Lurie (697) made up a test of 144 items presumably related to Spranger's value types. The four basic attitudes appeared to be social Philistine, theoretical, and religious. Line and his associates (691, 692) gave tests of reaction time, word association, oscillation, perseveration, and the Bernreuter scores. The major factor emerging from analysis was called "objectivity" and thought to be related to Spearman's *w*; another factor was something like *f*. Carter, Conrad, and Jones (578) analyzed children's annoyances by a factor method and distinguished: (a) general annoyability, (b) annoyance at dirt and disorder, and (c) annoyance at something like injuries to self-esteem.

Integral Personality

The most significant trend in personality measurement has been from measures of single traits to methods which allow for the expression of many characteristics of the personality in their natural structure and relationships. This necessarily involves a rather free situation in which subjects can impose any desired structure upon fairly plastic materials. The statistical methods developed for measures along single linear scales are not very helpful in treating these more comprehensive patterns. Vernon (828, 829) used a method of matching to bring out correspondence of the voice, photograph, and interpretative personality sketch for the same individual. Vernon's summary of results so far obtained in matching experiments indicated much closer relationships than correlations of single measures have usually given.

The Rorschach test has now attained the position of an outstanding instrument in the measurement and diagnosis of personality. Nearly forty studies employing the Rorschach test should be covered in this review. The *Rorschach Research Exchange* is now in its second volume. Most of the work on this essentially qualitative rather than quantitative method has been in the direction of clinical validation by correlation with the results of other diagnostic procedures, rather than the establishment of statistical norms. A third edition of Rorschach's original monograph (758) was published, and it is reported that an English translation will soon be available. Beck (553, 554) published several articles and the first book on the method in English. Kerr (666) gave the test to a large group of normal and defective children and found that the blind diagnosis agreed with the case histories. Kerr's study (667) of twins showed some similarity but by no means identity of personality pattern. Ganz and Loosli-Usteri (623) used the method with forty-three feeble-minded boys and found definite characteristics which distinguished their performances from those

of normal children. Marinescu, Kreindler, and Copelman (707) found that the interpretation of the Rorschach ink-blots seemed to follow the same laws as the conditioned reflexes of Pavlov. They applied the interpretation of the blots and their proposed physiological explanation to a study of the cerebral activity of twins, and found that this activity is very similar in twins and not at all similar between brothers and sisters of twins. Hertz suggested a method of administration (640) and published a historical summary of the literature (641), reviewing 152 titles. Hertz (642) also published Rorschach norms for the adolescent age group based on 300 junior high-school students.

Rosenzweig (760) outlined a project for validating the Rorschach method as a diagnostic instrument for functional mental disorders. The method is that of correct matching of case summaries and Rorschach interpretations. Schneider (767) discussed the application of the Rorschach to the measurement of vocational aptitude. Vernon (832) attempted the correlation of results on the Rorschach with other expressions of personality. He reported a correlation of $.78 \pm .06$ between Binet scores and the clinician's ability to estimate his subjects' intelligence from reactions on the Rorschach. Using a matching technic, 36 of 55 matchings were correct, yielding a contingency coefficient of $.83 \pm .03$. From experience with more than 350 subjects, including 100 normal adults, Guirdham (632) published a critical review of the method. G. E. Gardner (624) classified and tabulated the responses to the Rorschach blots of 100 normal adults of average I.Q. Klopfer and Sender (676) published a system of refined scoring symbols. Schachtel and Hartoch (766) noted that responses came in phases, and suggested a study of the sequences within the test, as well as the total scores for the test as a whole. Wells (840) compared and contrasted Rorschach procedures with association tests. Piotrowski (748) found that there are specific signs the presence of which in a record indicates that the personality of the subject has been affected by an organic disease of the central nervous system.

Klopfer (675) reviewed critically the recent theoretical developments in the Rorschach method. He (677) also published instructions for the administration of the test. Sunne (807) published norms for young children based on tests of 1,655 white and 2,068 Negro children living in New Orleans and 712 southern mountain children, and compared the Rorschach results with mental ages computed from intelligence tests. Beck (554) concluded that it is not possible at all times to interpret the same Rorschach factor as having precisely the same personality value. The trait meaning of any psychological process cannot be known, even after the process has been identified, until there is a picture of the personality as a whole. Vernon (831) published a summary covering publications since his review two years earlier. Skalweit (780) and Bleuler (561) engaged in a controversy over the relation of constitutional factors to the personality pattern revealed by the Rorschach. Fränkel and Benjamin (618) commented particularly on the subject's self-criticism during the Rorschach test. An

attempt at comparing races was made by Hunter (653), who tested 100 white and 100 Negro adults of comparable intelligence, education, occupation, and environment. The white group was more introverted, the Negroes more extraverted. An article by Juarros (663) indicated interest in the Rorschach method in South America.

Another test based on pictures uses more definite representation of persons expressing affect in undefined situations. Morgan and Murray called this a "Thematic Apperception Test" (720). Subjects are asked to tell what may be in the mind of the person in the picture, what has probably happened to bring this about, and what is likely to develop as a result. The large range of freedom permits the subject to formulate the story in accord with determinants from within his own experience. Sterzinger (795) experimented with pictures each designed to arouse one of the instincts named by McDougall. The Schwartz social-situation test is made up of pictures presenting rather definite misbehavior by children. Harriman (635) used it with delinquent women. The "hen test" used by two Polish psychologists (659) in exploring moral feelings of children from eight to fourteen years of age, is based on a cartoon of two boys whose malicious prank causes the cruel death of four hens.

Graphology is still a disputed area. Cantril and Rand (574) conducted one of the best experiments. Six subjects, each of whom was markedly representative of one of Spranger's value types, prepared a sample of handwriting which was then to be classified by 26 graphologists and 26 laymen. The marked success of the graphologists ($C = .93$) as compared with the indifferent results from untrained persons ($C = .17$) indicated that expertness should be respected. Practically all graphologists agree that diagnosis from handwriting, as from a Rorschach test, must be made in terms of an integrated picture, not in terms of item-by-item correlation of handwriting details with character traits. Hence experiments like Stackman's (785) are hardly relevant. Inui (656) reported that the best estimates are made by comprehending the writing rhythm. Pohl (750) theorized about the relative competence of cyclothymes and schizothymes, Feuerstein and Schönfeld (590: 611-27) about differentiating handwriting of different specialized groups among physicians, and Reinhardt (753) about heredity and environment in the graphological analysis of twins.

Stagner (787) tried to discover by rating specific aspects of voice and of personality (twenty-five judges and ten speakers), on what the judgments of personality from speech were based. Aggressive behavior and nervousness seemed to exert a clear influence on both judgments. Lange (684) found still photographs a poor method for estimating good automobile drivers.

Observation

Direct observation of behavior in natural life situations combines some of the advantages of objective testing and some of the freedom in the sub-

ject's self-expression which is required for interpretation in terms of the whole personality. If records can be made quickly and accurately, and without distorting the naturalness of the behavior, this is probably the most valid approach to personality testing. The sound motion picture would probably be the ideal recording instrument except for the expense and the problem of arranging it so that the subject does not know his behavior is being recorded.

Technics of observation have been worked out particularly by clinical psychologists and in the child development field. The trend is away from the Dorothy Thomas type of recording of single elements, toward more integrative description of the action-in-situation. Weiss (839) described the way in which behavior may be observed in the waiting room of a guidance clinic. Fries (621) made good use of observation in a play group. Homburger (646) asked college students to carry on dramatic play with children's toys, and found the play revealing inner emotional tensions; Kinder and Humphreys (668) found the examination of mental defectives facilitated by observation of their free behavior in a situation which offered a variety of test objects. Washburn (836) improved the technic of recording activities among young children. Randall (751) described an "anecdotal behavior journal" such as might well be kept by every progressive teacher, to give evidence of child needs and of personality growth under tutelage. Pistor (749) observed the group action, cooperation, development of individual interests, and fostering of creative ability among school children, and used the results to help in evaluation of progressive education. Huth (654) who once was an exponent of a variety of specific psychological tests, apparently has concluded that the best evidence for judging personality is obtained from the continuous observations of parents, teachers, and youth leaders.

More specific aspects of behavior have been brought under observation in other studies. Eisenberg (612) recorded the gait, speech, gestures, words, and other forms of expression related to feelings of dominance. Strehle's book (801) attempted an analysis of the meaning of posture and motion and gestures in each part of the body. A rating scale for the amount of energy and vigor expressed from moment to moment in the activities of children was developed by Fales (615). Childers (587) found insecurity at the root of much of the hyperactivity. Shacter (771) recorded the time during which children could sustain their interest in simple tasks, and compared the results with ratings on introversion, using the Marston scale. Dudycha (606) studied punctuality in a variety of situations and concluded that considerable consistency could be found in the habitual behavior of given students. A very excellent record based on several approaches to behavior in young children was worked out by Markey (708).

Two fruitful suggestions for further observation are worth noting. Gemelli (626) urged the study of how the individual meets new and difficult situations, as better than the more static classification of types. He suggested

that tests, interviews, motor tasks, and general behavior observation might all be used to supply data on the individual pattern of adaptation. Rosenzweig (761) proposed a test in which subjects work at insoluble problems. The question is whether, when the subject gives up, he blames the task, blames himself, or finds excuses for all concerned.

An excellent review of contributions to child development, largely by observation methods, has been prepared by Jones and B. S. Burks (662).

Combinations of Measures

Occasionally a study achieves exceptional value because of its use of a variety of approaches no one of which alone could have contributed so much. An outstanding example is L. B. Murphy's study (725) of sympathetic behavior in children. Most of the data were gathered by prolonged observation in a nursery school situation, but these were illuminated and supplemented by sociological study of the home and neighborhood, excellent rating scales, conduct tests in controlled situations, case studies, sociometric analysis, Rorschach test results, and analysis of findings in relation to various theoretical systems. A technic of special value was the use of a dial rather than the traditional profile for graphic representation of strong and weak aspects of the all-around personality. A lesser study of sociability by Bowley (565) used observation of social contacts, verbal social responses, and a social index. Dimock (603) made a long-term study of adolescent boys, including physical measures, mental tests, the Sweet Personal Attitudes Test, moral knowledge tests, rating scales, behavior observations, participation records, and other data. Even more comprehensive studies are in process in the California Growth study. Simoneit (777) described the combination of tests, ratings, interviews, and observation applied in the selection of German army officers.

Many forms have been prepared for recording data about individuals. Van Alstyne (823) described the record system at the Francis W. Parker School in Chicago, which makes a place for the cumulative recording of classroom observations, test results, ratings, questionnaires, and objective data. A German school psychologist (764) outlined his method of pupil analysis including the following: informal observation; data on health; family and environment; analysis of pupil's speech, writing, drawing, bearing, skills, and emotional life; test results; and the personality seen as a whole. The Roumanian government makes compulsory in public schools a personality inventory (622, 716, 727) based largely upon observation but including: intelligence tests; tests of memory, attention, imagination, etc.; data on heredity, social environment, and cultural level; family; results of medical examination; data on emotivity, temperament, will, and character; and a general personality characterization. The record is presented at school-leaving as a basis for vocational guidance.

CHAPTER VII

Applications of Tests of Non-Intellectual Functions¹

CHARLES CECIL UPSHALL

THE PERIOD UNDER REVIEW has been very prolific. Approximately 1,000 studies, investigations, articles, and books have appeared on the topics covered in this chapter. Nearly 500 studies were found which used measuring instruments, for example, questionnaire type tests, self-ratings, ranking of interests, ratings of others by experts or groups, time sampling procedures, more or less controlled observation, controlled or free interviews, and association tests. Over 500 titles were found which indicated that problems of personality, character, delinquency, and personnel procedures had been discussed or evaluated.

Out of this large number of references, 120 studies have been selected for special consideration in this chapter. The following criteria of selection have been applied: studies which used the best experimental technics were first selected; studies containing large populations were included rather than those with small populations when similar problems were being studied; other things being equal, those studies which made use of the most complete statistical procedures in reporting results were chosen. The number was further limited by giving preference to those studies which used well-known measuring instruments. Exceptions to this rule were made when the excellence of the study and the significance of the results seemed to justify inclusion in this review. Finally, in those fields where there were a large number of studies, those were selected which gave the truest picture of the conclusions drawn from all.

The studies reviewed have been grouped under the following captions:

1. Investigations of personality in so-called normal populations
2. Investigations of personality in clinically abnormal populations
3. Attitudes and interests
4. Character, behavior, and delinquency
5. Occupational fitness and guidance.

Personality—Normal Persons

Marital relationships—Many interesting facts about the personalities, adjustment problems, and mental hygiene of married people have been reported during the 1935-37 period. Many different measuring devices have been used. Schooley (951) found that the 80 married couples which were studied tended to be more similar in personality than random individuals at the beginning of their married life and grew more similar with time.

¹ Bibliography for this chapter begins on page 353.

Willoughby (981), in a detailed study of 152 married couples found, among many other things, that husband and wife tended to be alike. For example, the coefficient of correlation between the neuroticism score of the wife and that of the husband was .27. Johnson and Terman (918) compared the personality characteristics of happily married, unhappily married, and divorced persons. The unhappily married gave evidence of being more neurotic and introverted, having more intolerant attitudes and more volitional inadequacy than the happily married. The latter had more uplift interests and social adaptability. The happily married men showed more tolerance and sympathy than the happily married women. In general, divorced women had more self-reliance, independence, tolerance, initiative, and conative intensity than the women in the other two groups. Both men and women who were divorced had more intellectual interests than either of the married groups. Terman and Buttenwieser (973) gave the Bernreuter Personality Inventory and the Strong Vocational Interest Blank to married couples. The relationships obtained between the scores of husband and wife were small but positive. Some items proved to be diagnostic of marital compatibility. Bernard (871) also studied the problem of personality factors in marriage by means of the Bernreuter Personality Inventory. He found a few positive relationships such as those between (a) health of husband and his marital dissatisfaction, (b) health of wives and marital dissatisfaction of husbands, (c) use of birth control methods and neuroticism in women, (d) neuroticism and marital dissatisfaction in women.

Adjustment—Conklin (883) gave the Thurstone Personality Schedule to 100 college students in an effort to find the influence of family adjustment on the neuroticism score. Those who admitted family difficulties manifested a greater tendency to abnormalities of personality than those who did not. Crook (886) studied the constancy of neuroticism scores and self-judgments of constancy among college students. The Willoughby adaptation of the Clark-Thurstone Personality Schedule and self-ratings of change were used. Applications of the measuring instruments were made in September and May. Neuroticism scores were found to be less stable than intelligence ratings. Self-ratings of change were very inaccurate with a constant error favorable to the student.

Willoughby (982) gave a modified form of the Thurstone Personality Schedule to more than 500 unmarried women whose ages ranged from fifteen to seventy-eight years. Age, education, and consciousness of a current emotional problem were related to emotionality; occupation was not. Dario-tis (887) concluded after an intensive study that the validity of the Thurstone Personality Schedule is "highly questionable" as a measure of neurotic tendencies among college students. Hardy (908) made an interesting study of the adjustment scores of adolescents having a history of frequent illness during childhood. A low negative coefficient of correlation was obtained between frequency of illness in childhood and personality adjustment scores during adolescence or early maturity. Burnham and Crawford (880) stud-

ied the vocational interests and personality of a pair of dice as these were indicated by the Strong Vocational Interest Blank, the Bernreuter Personality Inventory and the Thurstone Personality Schedule. No one should use any of these three inventories for the purpose of making recommendations for individuals until they have read this study. The answer to each item on ten copies of each scale was determined by throwing a pair of dice. The Thurstone Personality Schedule showed that the dice were emotionally mal-adjusted; on the Bernreuter Inventory the percentile ranks were well above 50 when each section of the scale was arranged from the most to the least desirable traits. Nine of the ten vocational interest blanks indicated an interest pattern typical of successful Boy Scout masters. The authors make the following pertinent statement: "From these data it may be concluded that it is perfectly possible to secure by chance scores on these tests of a nature which, if made by human subjects, might be regarded as significant, and which in present practice are frequently so interpreted." Keys and Guilford (1920) arrived at the same conclusion for the Bernreuter Personality Inventory.

Brown (876) studied, by means of the Brown Personality Inventory, the influence of race and locale upon the emotional stability of 712 children. Differences in race and locale were not related to emotional adjustment but adjustment was related to socio-economic level, the higher level being better adjusted. Duggan (895) found physical education majors more stable emotionally, more extraverted, and more dominant than undergraduate women who were majors in other subjects. Forlano and Axelrod (903) studied the effect of repeated praise or blame on the performance of fifth-grade children who were classified as introverts or extraverts by means of the Pintner personality test. The introverts made gains in the learning situation sooner than the extraverts. In general, both groups of these children made better progress as a result of blame than of praise. Forlano and Watson (904) found that groups which were successful in military training were consistently more extraverted than those which were not very successful or were failing. Extraversion was measured by the Inex Self-rating Scale.

Family resemblances—Family resemblances in personality traits as measured by personality inventories of the questionnaire type have been studied sufficiently to indicate certain consistent trends. Pintner and Forlano (943) gave two questionnaire type personality tests to 137 pairs of siblings in Grades IV to VIII, inclusive. The intersibling correlation on an intelligence test was .23, on one of the personality tests, .19, and on the other .20. Siblings of the same sex were more alike than siblings of opposite sex. Sward and Friedman (968) gave the Bernreuter Personality Inventory to 387 triads composed of mother, father, and offspring. Temperamental resemblances were lower than resemblances in intelligence or physical traits. Children tended to resemble the parent of the same sex more than the parent of opposite sex. Carter (881) found that identical twins tended to be more

similar on the Bernreuter Personality Inventory than fraternal twins. When the 133 pairs of twins were compared with a control group, the twins were more extraverted, self-confident, sociable, gregarious, and stable. No significant differences between twins and controls were found for dominance or self-sufficiency. Yule (1986) gave a battery of tests of the Stephenson type to 115 pairs of twins and a control group of 60 unrelated children. Monozygotic twins were more alike than dizygotic and dizygotic of like sex were more alike than those of unlike sex. Ushijima (1976) found a coefficient of correlation between father and daughter of .207 and between mother and daughter of .304 when the Awoji and Ohabe Extraversion-Introversion Test was used. Stagner and Katzoff (1963) studied the relationships between personality as measured by the Bernreuter Personality Inventory and order of birth and family size. Order of birth was not related to personality. A little more independence was found in those who had younger brothers or sisters and there was a slight personality advantage in favor of those from small families. Schubert and Wagner (1953) used a modified form of the Woodworth-Mathews personal data sheet with 229 boys and 248 girls in high school and 117 transient boys. The transient was particularly maladjusted to his family situation but on the whole he was relatively stable emotionally. The academically successful boy and the academically unsuccessful girl were more unstable than the other high-school seniors; only children did not show as many signs of unbalance as those of larger families.

Racial differences—Shen (1955) found that the Chinese were more neurotic, more introverted, less self-sufficient, and less dominant than Americans as judged by their responses to the Bernreuter Personality Inventory. Chou and Mi (1982) found that Chinese and American students differed in the same direction on the Thurstone Personality Schedule when used in a Chinese translation with 850 Chinese students. Pai, Sung, and Hsii (1937) gave the Thurstone Personality Schedule to 617 Chinese males. The mean score was 51.82. The coefficient of contingency between the neurotic score and the clinical diagnosis was .47. Sward and Friedman (1969) compared the responses of 625 adult Jews with those of 625 adult non-Jews on the Bernreuter Personality Inventory and the Hiedbreder Introversion Inferiority Questionnaire. Neurotic and inferiority scores of Jews exceeded the mean of the non-Jew group by about 60 percent. Sward (1970) gave the Bernreuter Personality Inventory to 114 Jewish families and 113 non-Jewish families. Four distinguishing patterns were found for the Jews: (a) gregariousness or strong social dependence, (b) submissiveness, (c) drive and over action, (d) various anxiety states. Garth and Garth (1906) gave the Allport A-S Test to 269 educated Indians and 101 white males. The white males were definitely more assertive than the Indian males.

Social maturity and adjustment—Oldham (1935) found no significant relationship between the socio-economic status of 319 adolescent Negro girls and personality as measured by a battery of intelligence and personality tests. Diamond (1888) found a definite relationship between change in

personality and radical political activity but could not define the exact nature of the relationship. Symington (971) gave a battery of personality and mental tests and questionnaires to ten groups of subjects totalling 612. Two hundred and eighty-seven had a conservative religious background and 325 had a liberal religious background. Liberalism in religious thought was not related to the types of personality measured by the Bernreuter or the Allport A-S tests. There was positive relationship with intelligence, amount of education, and attendance at college courses of a liberal type.

Pintner, Forlano, and Freedman (942) found that chronological age and mental age were more closely related to choice of friends than personality and attitude test scores. Eight hundred and nineteen pupils in Grades V to VIII were used.

Kirkendall (921) found no relationship between changes in adjustment and changes in home environment when these were measured by the Symonds Adjustment Questionnaire and the Myers Intra-family Questionnaire. Age bore some relationship to changes in adjustment, and the adjustment of over-age pupils presented a more acute problem than that of under-age pupils. Young, Drought, and Bergstesser (985) found that neither scores on the Bell Adjustment Inventory nor scores on the Wisconsin Scales of Personality Traits were related to the discrepancy which existed between the predicted scholarship of University of Wisconsin freshmen and their actual scholarship. They concluded that "emotional factors, as such, are not important apart from the inner state or attitude of the person experiencing that situation."

Houtchens (916) used the Luria version of the free association test with three groups of junior high-school boys. One group, in the opinion of their teachers, was composed of boys least well adjusted, another was composed of boys who were best adjusted, and the third served as a control group. The conclusion was reached that teachers select as their best adjusted children pupils who, according to the test, are maladjusted.

Bradway (875) and Doll and McKay (894) used the Vineland Social Maturity Scale to study the social maturity of three types of handicapped children. Bradway found that a group of 92 deaf children, of ages five to twenty, were 20 percent inferior in social competence at each age level. Doll and McKay matched 38 children from the special classes in Vineland, New Jersey, with 38 children of similar chronological and mental ages who were living in the institution. The scale showed that special-class children were superior to institutional children in social maturity and especially on those items of the scale where self-direction carried the most weight.

Miscellaneous—Habbe (907) found no personality differences between 48 boys with normal hearing and 48 boys with impaired hearing on three measures of personality. There were more speech difficulties among those boys whose impairment of hearing was 15 decibels or more. Brunschwig (878) found very few significant differences on personality traits between a group of children with normal hearing and a group with impaired hear-

ing; the hearing children were higher in social adjustment. Meltzer (929) gave the Rorschach Ink Blot Test to stuttering and non-stuttering children. The stutterers were more talkative than the non-stutterers. Rate of speaking was about the same for the two groups. A description of certain variations in the responses of the two groups was given. Stone and Barker (965) found no significant differences between postmenarcheal and premenarcheal girls of the same chronological age on the Bernreuter Personality Inventory. Significant differences were found between the two groups on the Pressey Interest Attitude Scale and the Sullivan Test for Developmental Age. Wrenn, Ferguson, and Kennedy (983) found no significant differences on the neurotic and introversion scores of the Bernreuter Personality Inventory between one group of junior college students selected from the upper 5 percentiles of an intelligence test and another group selected from the lower 15 percentiles. Superior men and women were found to be more self-sufficient and inferior men more dominant.

Ayer and Bernreuter (867) studied the relationship between discipline and personality traits in little children. There was a positive relationship between attractive personality traits, as measured by the Merrill-Palmer Personality Scale, and allowing children to profit by the natural result of their acts. Bartlett (869) found no significant relationships between suggestibility as measured by the Hull "Sway Test" and personality traits as measured by the Bernreuter Personality Inventory and two of Maller's character tests. Mott (932) found a coefficient of correlation of .66 between personality as measured by Marston's Personality Scale and activity ratings derived from children's drawings. Line and Griffin (925) used Thurstone's multiple factor technic in analyzing the results from a battery of tests to find the factors underlying mental health. Two factors were found which separated the unstable from the stable. Factor one was probably related to "objectivity" of response; factor two was probably related to "fluency" or "mobility" of response. Brown (877) obtained a mean score on the Brown Personality Inventory of 24 for orphan boys from an institution. The mean score for the girls was 29. The mean score for boys living with their parents was 17 and that for girls 18. The mean score for boys living with their parents but having a low economic status was approximately the same, 23, as the mean score of boys from an institution. Schott (952) found marked differences between the means of three groups (200 normals, 130 applicants for professional positions, 300 neuropsychiatrics) on the Thurstone Personality Schedule. The schedule, however, failed to show the degree of maladjustment. Terman and Miles (974) made extensive studies of the relationship existing between sex and personality by means of masculinity-femininity tests.

Personality—Abnormal Persons

A majority of investigators who have used the questionnaire type inventories of neurotic tendency, or the various free association tests, with reason-

ably large groups of unselected normals and groups diagnosed by clinical methods to be psychopathic, have found statistically reliable differences between the groups; but there always is too much overlapping for the measuring instruments to be relied upon to give a true prediction in the case of any given individual.

Dimmick (889) used the Rorschach Ink Blot Test with 85 cases of dementia praecox of three clinical subtypes. Although several differences between the clinical subtypes approached statistical significance, the author thinks that the test needs more objective classification of the responses before it will be of great use in clinical work. This conclusion was generally reached by the many men and women who used the test during the period under review. Preda and Popescu (944) used the 100 word list of the Kent-Rosanoff free association test with 40 normals, 20 men and 20 women, paired with 40 insane men and women. The differences between the two groups ranged from 5 percent to 30 percent. It was also found that complexes are most important in the case of women. Preda, Stoenescu, and Cupcea (945) used Jung's free association method with 30 mental patients, with the following results: the reaction time of manics was relatively short; a delayed reaction showed the existence of certain traumas and complexes. They concluded, however, that it was impossible to differentiate objectively between certain important preoccupations of the patient, his delusions, and complexes by this method alone. Heuyer and Courthial (912) found that a combination of a modification of the Woodworth-Mathews personnel data sheet and the Pressey X-O Test yielded results which were in agreement with careful psychiatric findings in 75 percent of the 114 cases studied. McNemar and Landis (927) gave a simplified form of the Willoughby Emotional Scale to 65 psychopathic women. There was no relationship between whatever the scale measures and age, educational status, or clinical diagnosis. Williams and Mendenhall (979) gave the Hull "Sway Test" for suggestibility four times to 100 epileptics. Eighty percent gave the same response all four times. The group had a much larger proportion of zero scores than normals. Stoenescu (964) gave the Toulouse-Pieron Attention Test to 148 insane people. The range of mean scores was from zero for idiots to 108 for the paranoia group. The normal score is given at 134. Page (936) studied the relationship between superstition and personality by means of a questionnaire and the Heidbreder and Neymann-Kohlstedt Introversion Tests in 50 manic-depressive cases, 50 dementia praecox cases, and 50 normals. Belief in 6 of the 25 superstitions was reliably more frequent in the psychotics than in the normals. No consistent relationship between introversion-extraversion and belief in superstition was found among the normals.

Attitudes and Interests

The Thurstone Attitude Scales have been used extensively during the three-year period under review. Attitude toward war has been a favorite

subject of study. Sowards (959) used Thurstone's Attitude-toward-War Scale with high-school seniors, college freshmen, and college seniors in the same community. He found that the trend was consistently toward pacifism as more schooling was obtained but that the differences between the groups were not statistically reliable. Farnsworth (902) used the Peterson-Thurstone Attitude-toward-War Scale and the Bernreuter Personality Inventory with the same group of college men in 1932, 1933, 1934, and 1936. There was no change in score at the end of the first year but in both 1934 and 1936 there was a slight change in the direction of pacifism. He found no relationship between attitude toward war and scores on either the Bernreuter Personality Inventory or the Thorndike Intelligence Examination for High School Graduates. M. Smith (957) used the Droba-Thurstone Attitude-toward-War Scale with University of Kansas elementary sociology students. There was a shift towards pacifism during the semester of five-tenths of a scale point. Women were more against war than men. Pihlblad (941) used the Peterson-Thurstone Attitude-toward-War Scale with 484 men and women from one college and 100 men from another college. He found great unanimity of opinion. There was a definite piling up of the scores at the point in the scale which indicated mild opposition to war. He suggested that perhaps the scale is too insensitive to be used as a satisfactory measure of American college students' attitudes toward war. Traxler (975) used the Droba-Thurstone Attitude-toward War Scale with high-school pupils. At this level the score was not related to educational level. Reliability coefficients of the scale ranged from .635 to .806. Doubt was expressed as to the validity of the scale for the measurement of attitude toward war of high-school pupils. Gardner (905) obtained evidence of change as a result of his teaching technic in a group of junior high-school pupils in attitude toward war as measured by the Peterson-Thurstone Attitude-toward-War Scale. Koga (924) gave the Peterson-Thurstone Attitude-toward-War Scale to 1,642 Japanese college students. Not many outstanding differences between the attitude toward war of Japanese and American students were found although the Japanese were consistently more favorable toward war than Americans. Stump and Lewis (967) had 80 ministers from several different denominations fill out the Droba-Thurstone Attitude-toward-War Scale. Five percent were described as neutral, the rest were strongly pacifistic. The older ministers were less extreme in their attitude toward pacifism. A coefficient of correlation between age and score on the scale of $-.337$ was found.

Attitude (prohibition)—Knower (922, 923) used the Smith-Thurstone Attitude-toward-Prohibition Scale in a controlled experiment involving approximately 1,000 subjects—25 percent of the experimental group showed statistically reliable changes in attitude as a result of the presentation of oral arguments. He also found that there were only low relationships between attitude-influencing factors such as speeches, speakers, and interest and intelligence. Gardner (905) concluded that accumulative effects of a

lecture, a story, and a "chalk talk" about the use of alcohol with a group of college freshmen caused a change in attitude toward prohibition as measured by the Smith-Thurstone Scale.

Attitude (social)—Eckert and Mills (900) studied the relationship between international attitudes as measured by the Neumann Test of International Attitudes and scholarship and certain social factors. The internationally-minded high-school senior had a higher scholarship rating than the nationalistically-minded senior. Religious affiliation and having an older sibling in college were more potent in determining international attitude than instruction in the social studies. Morgan and Remmers (931) found that there was greater liberalism in college students they studied in 1933 and 1934 than those whom they studied in 1931. The Harper's Social Study Questionnaire was used. The college students were found to be more liberal than their parents.

Newcomb and Svehla (933) gave the Thurstone Attitude Scales toward church, war, and communism to 1,568 individuals in 558 families to determine the extent of covariation of the attitudes within families and the factors upon which such relationships may depend. The obtained correlation seems to justify the conclusion that the personal influence of family members upon each other is effective chiefly through the kind of institutional influences which they bring to bear upon each other.

Attitude (toward the Negro)—Bolton (873) and Sims and Patrick (956) used the Hinckley Scale for measuring attitudes toward the Negro. Bolton obtained a reliability of .40 for the scale when used with southern students. These students showed no significant change in attitude as a result of increased knowledge of Negro education. In another experiment, Bolton (874) found that advanced students were more liberal in their attitude toward the Negro's social rights than were freshmen. These southern students were least willing to recognize those rights connected with social intermixture of the races. Sims and Patrick made an interesting investigation. One hundred and fifteen southern students in the University of Alabama were paired with 115 northern students in the same university. These groups were compared with a group of 97 students from Ohio University. The mean scores of the groups were 5.0, 5.9, 6.7, respectively. Length of attendance in college did not influence attitude toward the Negro but northern students attending the University of Alabama tended to become more prejudiced toward the Negro as they remained in the institution longer.

Attitude (students)—Buck (879), Stagner (962), and Wilke (978) studied student attitudes by means of questionnaires and self-rating devices. Buck used a 375-item questionnaire on moral attitudes, anxieties, interests, etc. Approximately 2,000 students were studied during the ten-year period of the investigation. The author concluded that the evidence showed there was a tendency for student opinion to become more liberal. There was a lessening of disapproval of debt and of socialism. Stagner found that students were more liberal than their parents, especially the girls. When

parents disagreed on political party, boys tended to follow their father and girls the mother. Wilke studied student opinion in relation to age, sex, and general radicalism by means of an attitude scale of his own making. He found no conclusive relationship although women tended to be more radical than men.

M. M. Smith (1958), in an excellent study of comparative social attitudes based on four populations of 1,176 high-school seniors, 288 parents of these seniors, 192 of their teachers, and 83 university professors, found little evidence that social studies instruction was effective in developing intelligent opinion toward issues basic to citizenship, beyond that which the students shared with their parents. A partial coefficient of correlation between the pupils' attitudes and the parents, with teacher or professor influence ruled out, was .61. The influence of the professors on the attitude of the seniors, when influence of parents and teachers was held constant, was indicated by .01.

Effects of depression on attitudes—Probably the most thorough investigation of the effects of the depression on the attitudes of individuals was made by Rundquist and Sletto (1949). Six scales designed to measure morale, feelings of inferiority, family adjustment, economic conservatism, attitudes toward law, and the value of education were made and administered to approximately 3,000 persons in a wide variety of economic and social strata. Differences in attitude toward the economic order were found between the employed and unemployed. In general, age, the fact of living at home or away from home, and the employment or non-employment of either or both parents were significantly related to attitudes. Men receiving relief were not characterized by feelings of inferiority. Peck and Beckham (1938) compared the attitude toward relief of children between the ages of seven and fourteen from three relief groups and two non-relief groups. Six hundred and eighty-six children were used in the study. All groups, except the work relief group, showed attitudes more expressive of unwillingness than willingness to receive government aid. Stagner (1961) studied the relationship between economic status and personality by means of the Wisconsin Scale of Personality Traits. Poverty had not improved the personalities of the 128 college students studied. Children from homes of low economic status tended to develop feelings of inferiority, traits of nervousness or emotionality, and social passivity or seclusiveness.

Miscellaneous studies—Rothney (1948) used the Allport-Vernon Study of Values Test with high-school pupils. He found no significant relationship between scores on this scale and achievement in high-school subjects. Corey (1884), in a carefully conducted study, used Miller's and Yeager's scales to evaluate attitudes toward teaching and professional training. Seventy-five college juniors and seniors in Wisconsin were used. A statistically significant difference was obtained between the means of the September and January tests. The change was in the direction of improved attitude toward teaching. There was a coefficient of correlation of only .30

between the September and January tests. Corey (885) found a coefficient of correlation between attitude toward cheating as indicated by a questionnaire whose reliability was reported as .91 and actual cheating of .02. The coefficient of correlation between actual cheating and temptation to cheat was .46.

Interests—Walters and Eurich (977) used the Minnesota Interest Blank with 426 women students. A comparison of the interests of freshmen and seniors showed that there was a high degree of permanency of interests during the four college years. Dimmick (890) used Miner's blank for the analysis of work interests with psychology students. Statistically reliable differences between the group which earned A and B grades and the group which earned D or E grades were obtained.

Dunlap (896) used the Dunlap Academic Preference Blank to study the relationship between constancy of expressed preferences and such factors as achievement and intelligence. Degree of constancy was shown by degree of change during the period of ten months which elapsed between two applications of the blank. Individuals varied from a constancy rating of 16 percent to 72 percent. The mean constancy rating was 54 percent. A positive relationship was found between degree of constancy and both achievement and intelligence. Symonds (972) asked boys and girls in two city high schools to rank fifteen major areas of life according to two specific points of view. Boys recognized money matters as productive of problems more than girls—on the other hand, girls stressed appearance and etiquette as productive of problems more than boys.

Character, Behavior, and Delinquency

Speer (960) investigated the extent to which the Bernreuter Personality Inventory could be relied upon to separate 58 children who were judged to have personality and character problems from 184 who were not problem cases. No significant differences were obtained. Mathews (928) used the Haggerty-Olson-Wickman Behavior Rating Scale to select two groups of thirty secondary-school boys. One group received the highest scores on the scale and the other was given the lowest out of 93 boys. Significant differences between the groups were found for such factors as: strained relationships between the child and his parents, attitude toward authority, social manners, persistence, and reaction to frustration. The only significant difference between the groups on the six scales of the Bernreuter Personality Inventory was for sociability. Jones (919) used a battery of character tests and teachers' ratings at the beginning and at the end of a year's work in the social studies, with approximately 300 seventh- and eighth-grade subjects, to determine the efficacy of three specific methods of teaching character and citizenship. This important experiment should cause marked changes in the teaching of the social studies. Only the experiencing plus discussion method yielded gains consistently greater than the gains made by the control group. Little or no improvement took place with any of the

three methods when the testing and teaching situations were quite different from one another. Retests after six months showed that the gains had been fairly well maintained.

Harriman (909) found a significant difference between the scores of epileptics and normals paired for educational status and chronological age on the Kohs Ethical Discrimination Test. The epileptic group made the lower score.

Meyering (930) used the Haggerty-Olson-Wickman Behavior Rating Scale and the Woodworth-Mathews Personal Data Sheet with 100 boys in a camping situation. The Haggerty-Olson-Wickman Scale scores were related to the number of actual problems revealed in the camp situation. Baruch (870), in an excellently executed study found many significant relationships between the behavior maladjustments of 33 young children and reported tension between the parents. Keys and Guilford (920) made a very significant comparative study of the validity of the Bell Adjustment Inventory, the Bernreuter Personality Inventory, and the Personal Index of Loofbourow and Keys for predicting problem behavior in ninth- and tenth-grade children. Their conclusion was that "for no test or inventory are the correlations shown sufficient for accurate prediction of the behavior of individual pupils." The Personal Index correlated higher ($r = .41$) with the criterion than any of the other inventories.

Delinquency—The most thorough experimental study of delinquency which appeared during the period under consideration was directed by Healy and Bronner (910). One hundred and five delinquent children were matched with 105 non-delinquent siblings of as nearly the same age as possible. The two groups were compared for degree of adjustment to the family, emotional experiences, etc. Many important differences were found between the delinquents and the controls: the delinquent group had less desirable developmental histories than the controls; they also tended to be more restless and hyperactive; 91 percent of the delinquents, as contrasted with 13 percent of the controls, had experienced pronounced emotion-provoking relationships with others. Hill (913) obtained ratings on 70 items of behavior for three groups, for example, 517 reformatory inmates, about 1,000 high-school pupils, and 148 adults. Nothing definitely symptomatic of delinquency was found. Durea (897) failed to find any significant relationship between ratings on the Furfey Developmental Scales and certain indicators of degree of juvenile delinquency. In another study, Durea (898) found a highly significant difference (critical ratio = 7.2) between a selected group of thirteen-year-old delinquents and a control group of similar age, on an adaptation of the Pressey Interest-Attitude Test. A statistically significant difference between a group of 115 delinquents and a group of 374 non-delinquents was also reported.

Pescor (940) gave the Neymann-Kohlstedt Test to 1,000 delinquents. A split-half reliability of .19 and retest reliability of .63 were obtained. The scores tended to be grouped in a neutral zone. Bartlett and Harris

(868) used a battery of tests in a controlled experiment to determine personality factors in delinquency. Delinquents showed greater emotional instability, more difficulty in maintaining satisfactory home, family, and school relationships, more participation in socially undesirable leisure-time activities, and a greater tendency to cheat on classroom tests. Durea (899) also found that delinquents were more retarded emotionally than normals of the same age. Houtchens (914, 915), in two matched pair experiments where delinquents were matched with non-delinquents for chronological age, intelligence quotient, socio-economic status, and school grade placement, found that there was a coefficient of correlation of .645 between conflict scores derived from a combination of the Kent-Rosanoff word association and Luria tension pressure technics, and delinquency. The distribution of conflict scores was found to be bi-modal. The two groups differed most in qualitative analysis and pattern response.

Vocational Fitness and Guidance

Studies of teachers—Sandiford and others (950) used the Bernreuter Personality Inventory as one of the measures in their excellent studies on forecasting teaching ability. They concluded that "ability in practice teaching is not measured by 'personality tests'; in fact, considerable doubt exists at the present time as to what, if anything, these tests do measure. Measurement of personality traits is of no value if these traits are arbitrary and unrelated to other phases of human life." Heilman and Armentrout (911) used the Purdue Rating Scale for Instructors in studying class reactions to twenty-three teachers at two different times five to seven years apart. Trait means for individual instructors were not highly reliable. Engelhart and Tucker (901) had 224 high-school pupils underline on a 100-item list of traits those of the best teacher. Traits receiving high ratings were: clearness in explanation, tolerance, sincerity, impartiality, and interest in pupils. Nogami and Sato (934) obtained ratings of an ideal teacher from 2,238 pupils in the middle, normal, and higher schools of Japan. Character and sympathy stood highest, while cooperation and personal appearance were among the lowest. Yeager (984) studied by means of personality tests and questionnaires, the traits of high-school seniors interested in teaching. One hundred and nine seniors were compared with 500 unselected seniors. The weakest point of high-school girls interested in teaching, when compared with unselected girls, was personality. The weakest point of high-school boys interested in teaching was intelligence. Peck (939) studied the adjustment difficulties of three groups, for example, (a) 100 women teachers, (b) 26 men teachers, (c) 52 women students. The Thurstone Personality Schedule was used. The group of women teachers was less well adjusted than either the women students or the men teachers.

Williamson and Darley (980) made the most complete and systematic evaluation of guidance work published during the three-year period. It is suggested that every personnel program include plans for evaluating its

work. One thousand two hundred and seventy-three items of information were collected for 196 individuals who had 784 problems. Between five and fifteen tests were given to each case in addition to those given during the entrance test program. Of the 784 problems the three most common groups of problems were: vocational, 300; educational, 227; and social, personal, and emotional, 136. The suggestions, advice, and recommendations given to the students were classified and a follow-up study one or more years after was made. Satisfactory adjustment was made in 91 out of 94 cases who followed the advice which was given. Only three students out of 37 who did not follow the advice given at all made satisfactory adjustment. The authors caution readers against making careless generalizations from the results of this study. They promise a more extensive study of about 1,000 cases.

Salesmen—Husband (917) used the Wisconsin Scale of Personality Traits to study the differences in personality between 64 salesmen and 1,000 college students. The salesmen were reliably less neurotic, more self-confident, and more self-sufficient than the students. There was only a slight correspondence between the efficiency ratings of the salesmen and the traits measured by the Wisconsin Scale, but the better salesmen tended to be less neurotic and more extraverted. Schultz (954) also found that extraversion was somewhat predictive of selling success and that dominance to a moderate degree and intelligence above the 20th percentile are related to the prediction of success in selling. Bills and Ward (872) gave the Strong Vocational Interest Blank and the Bernreuter Personality Inventory to 96 casualty insurance salesmen. They also found that high Bernreuter scores were significant for predictive purposes. Both high and low scores on the Strong Vocational Interest Blank were useful in prediction. Dodge (893) studied the differences between clerical workers and salespersons on the Bernreuter Personality Inventory. The salespeople possessed more social dominance than the clerical workers.

Miscellaneous—Dimmick (891) found that some of the items in Miner's Blank for analysis of work interests differentiated graduate engineers from college freshmen. McIlnay and Jensen (926) studied 538 student flyers; extraverts had a slightly better chance of being graduated. Quayle (946) studied 124 stenographers, 63 of whom reported that they were happy and 61 that they were unhappy or doubtful of being happy in their vocation. The group filled out a 175-item questionnaire, the A-S Reaction Test, some of Maller's Character Sketches, the Otis Test of Mental Ability, the Minnesota Test for Clerical Workers, and the Strong Vocational Interest Blank for Women. Very few of the differences between the happy and unhappy groups were statistically significant. The happy group was different from the other on the following: as children they were not considered nervous, they were happy in school, deliberately chose business, and believe they have had a normally developed love life.

The extent to which several measuring instruments are useful in vocational guidance and counseling has been studied by many investigators.

Strong (966) used his Vocational Interest Blank in a five-year follow-up study of Stanford University graduates. He found close agreement between the choice of an occupation made during college and the results of the interest test given five years later. There was also close agreement between the interest test scores made in college and those given five years later although half the group changed their occupation within five years of leaving college.

Comment

The writer believes there has been certain improvements in the studies covered during the 1935-1937 period as contrasted with those of the preceding period. There was a considerable increase in the number of studies which used experimental and control groups; the standard errors of the statistical measures employed were more frequently reported; and there were many studies which used large populations (200 or more), although relatively few of these presented convincing evidence of the extent to which the populations used were representative of some large socially significant group.

The outstanding criticism of the studies under review, from the point of view of the "consumer" of research, is that, although the results are frequently significant for groups, the extent to which the conclusions apply to each individual of the group is not clearly indicated. Where the chief reason for making an investigation is to secure data that will aid in understanding and giving help to an individual, statistical measures should be applied which will show the extent to which this aim has been attained.

More studies are needed which cover a longer period of time, especially those dealing with changes which have taken place as a result of specifically described and controlled factors. In studies of the amount of change which takes place as the result of an experimental factor, measurement of extent of permanency after six months or a year should be made.

More emphasis should be placed by research workers on studies which may be validated in terms of socially significant behavior. The greatest of care should be taken to select a group as representative as possible of a large important population. By adherence to these two criteria educational research will be able to make a still greater contribution to our understanding of mental and social phenomena.

CHAPTER VIII

Developments in Statistical Methods Related to Test Construction¹

EDWARD E. CURETON and JACK W. DUNLAP

EDUCATIONAL STATISTICS have made considerable progress in the last few years. Only a short time ago the competent mathematicians interested in educational test theory and the competent educators conversant with even a minimum amount of mathematics could almost have been counted on one's fingers. Today there are dozens in each of these groups, and there is every reason to believe that in a few more years there will be hundreds. With the founding of the Psychometric Society in 1935 and the publication of the first issue of *Psychometrika* in 1936, the allied field of mathematical psychology may fairly be said to have become a recognized science.

Scoring and Computing Aids

The computational field divides naturally between the Hollerith methods and those which employ standard calculating machines. For the first group the handbook edited by Baehne (988) is already a classic. For the second, Dunlap's manual (1011) provides complete and detailed instructions.

Cuff (1003) devised a Testometer which scores a perforated answer sheet by weighting a set of plungers that drop through the correctly punched holes. The International Test Scoring Machine is emerging from the experimental stage (1050). When it becomes a little more generally available it should effect a revolution in mass scoring and in item analysis. New issues of the Strong Vocational Interest Blank and of nearly all the Cooperative Achievement Tests are being revised to use its special answer sheets.

A number of tables and nomographs to facilitate the computation of item-test correlations have appeared. The most generally useful of these, probably, are Dunlap's table of p/z (1012) and Kuder's nomograph (1064). Arnold and Dunlap (987) have also prepared a nomograph for computing Spearman-Brown correlations and their standard errors.

Scales and Scaling Methods

Chi (998) succeeded in measuring separately the reliability, "internal" validity, and halo effects in personality ratings. After correcting for halo he found that a single general factor plus specifics was enough to account for the intercorrelations among nineteen rated traits. He identified his gen-

¹ Bibliography for this chapter begins on page 357.

eral factor tentatively with Webb's "volition." Flanagan attempted to devise a scale unit for the Cooperative Achievement Tests that would be constant from test to test and from age to age (1002). Bradway and Hoffeditz (993) translated the important parts of Heinis' original paper on the personal constant. They also described the Vermeylen Scale on which it was based, and added a number of penetrating comments and criticisms of their own. Cureton (1004) pointed out the real meaning of the A.Q., repeated and extended Huffaker's derivation of its standard response error, and devised corrections for its systematic errors. Richardson and Stokes (1078) tested all the children in an English town (12,000 in number) at once, and confirmed Thurstone's finding that absolute variability in intelligence increases regularly with age, the standard deviation at any age and on almost any test being close to .18 times the absolute mean. Lorge (1067) discovered that all of the decreases in intelligence test scores with advancing age could be attributed to the speed factor.

The dividing line between mental test theory and psychophysics is rapidly disappearing. Guilford (1035) showed that the difficulty of a test item from the Seashore Tests of Musical Talent is inversely proportional to the logarithm of the stimulus-magnitude, and suggested that the unit of absolute scaling as applied to test items might become a satisfactory unit for psychophysical problems also. His recent text (1034) started with a consideration of psychophysics and worked from there toward mental test theory. Barnhart (989) applied pair comparison, order of merit (ranking), and single judgment (like-dislike) methods to the scaling of affective judgments on simple geometric forms, and found no significant superiority of the more complicated and time-consuming methods over the method of single judgments. Guilford (1036) found it possible to scale a series of items when each of a large number of judges had expressed only his first choice and his last choice. This method opens up the vast field of ordinary voting preferences to the methods of psychophysics. F. W. Irwin (1051) reviewed the literature of this difficult field admirably, and Woodworth's long-awaited monograph (1116) appeared in 1936.

In the related field of the theory of frequency distributions, Zoch (1120) pointed out that in all of the bell-shaped Pearson curves, the points of inflection are equidistant from the mode. This is a serious limitation in the case of skew curves, and often causes them to fit experimental data rather badly.

Correlation and Regression

Deming (1006) in a remarkable series of papers, generalized the theory of least squares, and pointed out that the validity of the chi-square test of goodness of fit depends on the assumption that the fitting was done by least squares. Hotelling's epochal study (1047) laid the foundation for an almost infinite variety of new extensions of the theories of correlation and

factor analysis. Bernstein (991) opened up the field of the theory of least absolutes again, and this may well become a legitimate competitor of the theory of least squares.

Hotelling and Pabst (1046) and Friedman (1026) provided exact techniques for tests of significance based on ranks. These tests avoid the assumption of normally distributed variates, and apply to most of the field previously covered by normal correlation and the analysis of variance.

A number of improved methods for computing partial and multiple correlations and regressions have appeared recently. McIntyre (1069) systematized the computations from raw data, Griffin (1033) simplified his previous simplification of Yule's method, and Mosak (1071) improved on Horst's generalization of the Doolittle method. Dwyer and Meacham (1014) reported a method for printing a correlation table on a Hollerith tabulator equipped with digit selection, provided one variate contains not more than ten categories. The tabulator provides marginal totals and cumulative (progressive) totals at the same time, from which means, standard deviations, skewness coefficients, and the correlation coefficient can be computed readily. The method can also be used to obtain the cumulative frequencies (progressive totals) of all columns at once, thus facilitating the computation of medians, quartiles, deciles, means, and standard deviations of ten variables simultaneously.

Stouffer (1095) showed how to correct partial and multiple correlations for attenuation. Cureton (1005) discussed the relations between experimental setups and reliability computations, and derived the standard errors of a number of commonly used correlation functions. T. L. Kelley (1058) presented a new formula for a correlation ratio unbiased by the arbitrary division of the data into categories.

Several recent papers have dealt with the perplexing problem of weighting several criteria to obtain a composite. Hotelling (1045) weighted them in such a manner as to minimize the mean square error of prediction by a definite battery of independent variates. Edgerton and Kolbe (1015) weighted them so as to minimize the mean square variation of the several standard-score criterion measures of each individual, without reference to any independent variates; and showed that this method also resulted in maximizing the standard deviation of the composite scores. Kurtz (1066) did not combine his criterion-scores at all, but showed how to weight two independent variates so as to maximize their average intercorrelation with several separate criteria.

Conrad (1001) and Ghiselli and Kuznets (1030) derived formulas for computing the correlation between a subtest and the remainder of the battery, or between an item and the remainder of the test. Dunlap (1010) derived formulas for obtaining the correlation in a large group, knowing the means, standard deviations, and correlations in several subgroups. Baten (990) solved a similar problem involving the skewness coefficient.

Reliability

Willoughby (1114), Sandon (1082), Goodenough (1032), Thouless (1099), Jellinek (1054), and Gulliksen (1037) discussed at some length the problem of the essential meaning of reliability. The varieties of fluctuation and error comprehended within the term include at least the following:

item sampling error	}	test errors
item weighting error		
motivational fluctuation	}	response errors
function fluctuation		
subjectivity error	}	reader errors
halo effect		
clerical error		

Various corrections and remedies have been proposed. Willoughby would eliminate items that differ only verbally from other items without calling for an actual reorientation of the examinee's thinking. Goodenough found that the odd-even correlation, "stepped up" by the Spearman-Brown formula, actually exceeded the test-retest correlation in several cases. Thouless described an experimental and statistical procedure for measuring function fluctuation. Jellinek preferred to use the intraclass correlation as a reliability coefficient. Gulliksen showed how to measure reader reliability and test reliability separately in an essay examination. Kuder and Richardson (1065) gave an extended analysis of test reliability in terms of the difficulties and intercorrelations of the items. Stephenson (1090) pointed out that for many purposes the saturation of a test with a general factor is more important than its reliability. This is of course only a re-emphasis on the priority of validity. Conrad and Martin (1000) dealt with the same problem in another way when they derived an "index of forecasting efficiency" ($E_{01} = 1 - \sqrt{1 - r_{01}^2}$) corrected for attenuation in the criterion.

Sampling Theory

The theory of small samples, involving as it does a great deal of mathematics beyond elementary calculus, has often proved a stumbling block to those whose backgrounds are primarily non-mathematical. These latter will welcome especially a paper by Jackson (1053) giving elementary derivations of several fundamental formulas, as well as two descriptive papers by Wilks (1112, 1113). The use of the more exact tests of significance has been extended in a series of brilliant papers by Fertig (1018, 1019, 1020, 1021), Dorfman (1009), Neyman and Tokarska (1074), Ricker (1079), and others. Conrad and Krause (999, 1063) extended the extreme tails of the Kelley-Wood table, and provided a new table of the normal probability integral giving values of x/pe for given areas.

The Analysis of Causation

Wright (1117) has given a new and complete summary of his important method of path coefficients. Johnson and Neyman (1056) and Kimball (1061) devised technics for determining the significance of the difference between two regression equations, making experimental pairing and equating of groups unnecessary, and increasing the amount of information on which the test of significance is based, thus generalizing the problem of matched groups.

Sterne (1093) solved approximately the problem of the distribution function for Rhine's extra-sensory perception experiments. Jellinek (1055) deplored the misuse of statistics by psychologists and psychiatrists, and reiterated the point that even good statistics do not improve bad data. Snedecor and Cox (1087) presented a number of new technics in the analysis of variance.

The general problem of the probability of correct matching has received renewed emphasis through the work of Vernon and others on personality estimates. It has been shown, for example, that given *general* verbal character sketches and photographs of unknown persons, a group of judges can match them correctly with a frequency far above chance—even though these same judges may fail to rank the pictures on any given trait in such a manner as to obtain a correlation with the correct ranking significantly above zero. Vernon (1108) reviewed most of this work. The mathematical problems and certain of their implications were considered by Chapman (996, 997) and by Vernon (1109).

Item Analysis and Validity

Merrill (1070) objected to the indiscriminate item analysis, and devised a modification of the chi-square technic to show whether or not a whole table of item-test correlation differences could be attributed to chance. Sletto (1086) showed that a population of at least 400 is necessary to determine stable item-discrimination values, and that items which are highly discriminative in one group may be non-discriminative in another. Mosier (1072) discovered eight independent factors among a set of items picked from a much larger set on the basis of high discriminating power. In the light of these findings, a number of studies dealing with the relative merits of different item-selection technics must be considered as of secondary importance. A possible exception is Horst's new method (1042), which is based on the item intercorrelations as well as on their correlations with the total test and with an outside criterion.

A number of writers have dealt with the problem of key-correlations in multi-trait tests such as the Strong Vocational Interest Blank and the Bernreuter Personality Inventory, and considerable controversy has arisen. The arguments were reviewed by Flanagan (1025), one of the principals in

the controversy, and the opposite viewpoint was presented in purely theoretical terms by Royer (1081).

Dickinson (1008), in a thought-provoking manner, discussed the essential meaning of validity, and the methods by which it is obtained.

The practical problems of item construction have been attacked by several investigators. J. M. Stalnaker and R. C. Stalnaker (1089) found that selected distractors (wrong alternatives) improved the validity of a multiple-choice vocabulary test, and V. H. Kelley (1059) found the "arm-chair" judgment of the test builder just as good as a laborious tabulation of errors on a recall test for producing such selected distractors. Votaw (1110) demonstrated that the use of do-not-guess instructions and the rights-minus-wrongs formula with a true-false test penalized the intelligent but submissive student unduly, and recommended the use of instructions to mark every item. Bird and Andrew (992) found by the criterion of internal consistency that one-word-completion items were more valid than recognition items, even though these recall items scarcely ever formed over one-fourth of the criterion-test. Feinberg (1017) made an intensive study of the responses to one word (*mellow*) from the Stanford-Binet vocabulary. He found that it was misplaced by six years from its correct difficulty level, that success in defining it was related to sex and age when mental age was held constant, and that on the credit side it has had a uniform meaning throughout its history.

Methodological studies have not been lacking. Remmers and associates (1077) successfully constructed generalized attitude scales by using a variant of the Thurstone technic. Kirkpatrick and Stone (1062) objected to the assumption of the attitude continuum and the method of equal-appearing intervals. Instead they preferred to define each item as *pro* or *con* in constructing a scale of attitude toward religion, and to group the items in logical categories. This led them to the development of a belief-pattern scale, which was shown to possess considerable discriminating power. Dunlap (1013) constructed items somewhat similar to Strong's, but with four responses (like, indifferent, dislike, and unknown), to measure children's interests in school subjects. These items were prepared with relation to specific subjects and validated against the appropriate subtests of the New Stanford Achievement Test. A few highly discriminative items were then revalidated against *other* subtests, where they often proved useful. He concluded that multiple weighting would be distinctly advantageous in reducing the length of the test. Young (1118) derived a residual index ($RI = Y - b_{yx} X$). With Estabrooks (1119) he used residual scholarships (test-intelligence constant) as a criterion in developing a studiousness-scale key for the Strong Vocational Interest Blank at Colgate University. Mosier (1073) used the scale on a different kind of a group (one that included technical students) at the University of Florida, and found it to be limited in its validity.

Several new studies on the scoring of the rearrangement test have appeared. The most serviceable scoring formula to date is that of Sims (1085): $\text{Score} = n - 3d/n$, where n is the number of items and d is the sum of the differences between the student's ranks and the key ranks. All negative scores are given the score zero.

Factor Theory

This has been the dominant subject in educational and psychological statistics during the last few years. Spearman's two-factor theory and Thomson's sampling theory, though eclipsed from time to time by the spectacular successes of rival theories, have continued to progress. J. O. Irwin (1052) showed that the indeterminacy in g could be reduced indefinitely by increasing the number of tests; Piaggio (1076) devised a method for determining g and s approximately; and Thomson (1098) showed how these estimates could be improved through the use of certain non-hierarchical systems. Thomson (1097) also presented a complete treatment of his sampling theory and concluded that g is a useful mathematical description but is not a psychological reality.

Thurstone (1104) published a definitive statement of his multiple factor theory, which has become the basic starting point for most of the later work in this field. His *Primary Mental Abilities* (1102) has just come from the press—too late for review here. Hotelling supplemented his classic paper (1044) by another (1048) presenting a simplified scheme of computation. T. L. Kelley (1057) described a variant of this technic and went on to discuss the fundamental problems of factor analysis in a cogent and penetrating manner. Holzinger (1041) developed his bi-factor theory, a theory intermediate between those of Spearman and the unrestricted multiple factorists, and then proceeded to embody it in the only treatment of factor theory which to date deserves the name "clear." Burt (995) devised a method somewhat similar to those of T. L. Kelley and Hotelling, and worked out comparisons between these methods and Thurstone's. Woodrow and Wilson (1115) described a variant of the centroid method which avoids the necessity for the rotation of axes demanded by Thurstone and gives meaningful factors from the outset. Horst (1043) proposed to use a method of computation proceeding directly from the score matrix, and giving all significant factors at once. Factors having small loadings could be discarded after the analysis was complete.

Frisch (1027) working entirely independently of the American and British groups, and upon a somewhat different problem, arrived at results whose resemblance to those of the factor theorists is startling. Everyone interested in the deeper implications of the theory should read his monograph.

Tryon (1106) proposed to discard "mathematical factors" entirely and to substitute "psychological factors."

A host of theoretical papers have appeared, seeking to clarify specific points and less commonly to point out relationships between the various theories. Only a few can be cited. Holzinger and Harman (1040) compared the bi-factor method with several variants of Thurstone's method, partly by mathematical analysis and partly by means of a worked-out example. Kellogg (1060) showed the relationships between Thurstone's early least-squares-iteration method (later discarded by Thurstone in favor of the centroid method), Hotelling's method, and Kelley's. His analysis was partly mathematical, partly computational, and partly, it would almost seem, intuitional. It checked, however, with the rigorous analysis of Girshick (1031), who showed that the principal components of Hotelling's method are maximum likelihood statistics and therefore subject to smaller sampling errors than any others, and that the method of principal components does not require as many factors as tests, and can be used just as well with communalities in the diagonals as with reliabilities or unities. From all this work it would appear that at present the most efficient factor-analysis method would start out with a matrix of raw correlations having estimated communalities in the diagonal cells, proceed by Hotelling's shorter method to a determination of the principal components, and end up with rotations as suggested by Thurstone. The research worker who is willing to sacrifice a little accuracy in order to avoid the admittedly large amount of work involved in the above recommendation would probably do well to consider the direct and simple method of Woodrow and Wilson (1115). The bi-factor method should always be considered as an alternative if the data seem likely to conform to its somewhat more restrictive assumptions. It is impossible as yet to evaluate Horst's new method, though a paper by Hoel (1038) provided a method for obtaining the necessary advance information regarding the number of factors that will be required.

The number of experimental investigations which have employed the factorial methods now runs into the hundreds. Only a few can be mentioned here at all. Thurstone (1100) applied 56 tests to each of 240 college students, and isolated 7 primary traits with some certainty and 5 others with some uncertainty. His latest work was not published in time for comment here. Holzinger (1039), working with nearly 100 tests and two groups of children aggregating about 1,100, found a general factor and 7 group factors. His group factors clearly resemble Thurstone's primary traits, though they are not identical. Holzinger's data are published in a series of pamphlets in such a manner as to permit any other worker to check his analyses or to apply other analyses to the same data. Mosier (1072), as has already been noted, analyzed 39 out of 42 of the most significant items from the Thurstone Neurotic Inventory, and found 6 clear factors and 2 more which were not so clear. Flanagan (1024) analyzed the 4 scales (not the items) of the Bernreuter Personality Inventory, and found 2 principal components for which he devised new scoring keys. His monograph pre-

sents a number of additional experimental and statistical results relating to the methodology of test construction.

Stephenson (1092), following up a suggestion of Thomson's, proposed to invert the factor technic by applying a large sample of tests to a small number of individuals. He would then compute the correlations between individuals and apply a factor analysis. Just as a test-factor is named by naming the tests in which it has high loadings, so an individual-factor would be named by naming the persons in whom it had high loadings. This analysis would lead, as the number of tests was increased, to a valid description of human types. Stephenson (1091) has carried the theoretical implications of this idea further in another paper.

Zubin (1121) proposed to score, not item responses, but patterns of item response. After selecting 140 items from among 632 for their ability to differentiate psychotics from normal individuals, he combined them in groups according to logical considerations, and scored them by means of contingency tables. Some groups of diagnostic items turned out to be non-discriminative as groups, while others turned out to be super-discriminative. On rather slender evidence he suggested that the optimum group should contain about five items.

Spearman (1088) defended the Taylor series approximations inherent in all mental measurement theory, and proved that in the case of factors which combine by multiplication instead of by addition, the two-factor hypothesis leads exactly to the tetrad criterion again.

Miscellaneous

The fundamental questions of scientific method, operational definitions, implicit and explicit assumptions, and the nature and meaning of measurement have been discussed by McGregor (1068), Scates (1083, 1084), Stevens (1094), and Thurstone (1103).

Burgess (994), in combining the results of 60 published studies to obtain two sets of composite growth curves for the heights of boys and girls, demonstrated the meaning of synthetic research in its highest form.

Hyde (1049) and Dickey (1007) have investigated the statistical concepts necessary for the reading of educational literature. Neither of their lists is very long, but both of their samplings of "educational literature" are rather narrow.

Since Toops and Kuder (1105) covered the field of the present review in 1935, Swineford and Holzinger (1096) have published a short but well-selected and annotated bibliography every year. Rider (1080) published a review of the more technical papers in mathematical statistics just previous to the appearance of the Toops and Kuder review.

A considerable number of new books on statistical methods have appeared recently. Those of most interest to educational statisticians will probably be (in approximate order of increasing technicality) the ones by Garrett (1028), Enlow (1016), Guilford (1034), Fisher (1023), Peters and

Van Voorhis (1075), and Gavett (1029). Walker and Durost (1111) have prepared a useful manual on the construction of tables. Uspensky's *Introduction to Mathematical Probability* (1107) and Fisher's *Design of Experiments* (1022) became classics in their respective fields upon publication.

Summary

The principal statistical developments of the last three years have been the following:

1. New aids for handling large masses of data with respect both to scoring and to computation.
2. An increasing tendency for psychophysics and the mental test theory to merge.
3. Further improvements in the theory of least squares, and the beginning of a systematic theory of least absolutes.
4. A critical attitude toward the concepts of reliability, validity, and item discrimination, and attempts to redefine and clarify these concepts.
5. Serious attempts to solve the problem of the combination of criteria.
6. The application of modern sampling theory and tests of significance to educational and psychological problems, especially to the problem of matched groups; and the revival and improvement of methods of analysis based on ranks.
7. A revival of interest in the chi-square and contingency methods, and a number of new applications of these methods.
8. A general attack on the problem of human types, through the development of the matching technic, the inverted factor theory, and the methods of pattern analysis.
9. Several new attacks on the problem of factor analysis, and the application of factorial methods to a wide variety of experimental data.
10. Attempts to restate the fundamental hypotheses of an educational and psychological science.

Needed Research

Much new research is needed in furtherance of the trends noted above, and a few important problems have been neglected during the last three years and should be given consideration again. The most important needs would include:

1. Further development of scoring machines, and the evolution of some plan for their more general distribution.
2. Further study of mental growth, both before and after maturity, including a determination of the actual mental ability of the average young adult.
3. A critical reexamination of score scales and the M.A., I.Q., E.Q., P.C., and A.Q., taking accurate studies of mental growth as the starting point.

4. Systematic exploration of the theory of least absolutes.

5. Research with large samples and homogeneous tests along the lines suggested by recent criticisms of the concepts of validity, reliability, and discrimination. These studies should determine, among other things, the absolute and relative magnitudes of the test errors and the response errors in mental tests.

6. Further studies on the combination of criteria, and the linking up of the findings with those in the allied field of index numbers.

7. The more general use of modern sampling theory and exact tests of significance. This will require much careful expository work to make the technics more generally available; and may in fact imply no less than a total abandonment of the idea of non-mathematical "elementary statistics."

8. Further studies of human types, using improved contingency-matching methods, inverted factor methods, and pattern analysis methods. It is possible that the basic unit of analysis may have to be the test *item* rather than the *score*. This will require still more efficient mechanical scoring aids and wholesale computation devices.

9. Synthesizing studies in the field of factor-analysis. The interrelations of the factorial methods must be explored more fully than they have been. The selection of a factor method should eventually cease to be a matter of argument, becoming simply a matter of picking the method whose rationale best fits the limitations of a given set of data.

10. Extension of the work on matched groups and the significance of the difference between regression equations to multiple-group comparisons and to multiple criteria.

11. Intensive study of the single test item in a wider variety of situations.

12. Further work on multi-test scales, leading possibly to a single scale to be scored for all interests, attitudes, adjustment trends, etc., which can be measured by such checklists in the first place; this work to be preceded by a careful analysis of the inherent reliability, validity, and significance of such lists.

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Chapter V. Vocational Aptitude Tests

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Chapter VII. Applications of Tests of Non-Intellectual Functions

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Chapter VIII. Developments in Statistical Methods Related to Test Construction

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Index to Vol. VIII, No. 3, June 1938

References in this Index are to the beginning of chapters and their subdivisions, and to the first allusion in running (perhaps intermittent) discussions. One should scan several pages following the one cited.

- Ability grouping, 251
- Acceleration, 251
- Accidents, 266; *see also* safety, emotions
- Accomplishment quotient, 244, 250, 308
- Adjustment, surveys, 293
- Aptitudes, *see* predicting school success, vocational aptitude, particular subject field
- Arithmetic, development of concepts, 236
- Art, aptitude, 263
- Athletic ability, *see* motor abilities
- Attitudes, measurement of, 269, 276, 312; surveys of, 298; *see also* racial prejudices, religious attitudes
- Automobile driving, 263; *see also* safety
- Aviation, aptitude, 265
- Birth rates, 243
- Causation, 310; *see also* correlation
- Character, measurement of, 269, 302; *see also* moral behavior
- Cheating, 285
- Child psychology, *see* infants, preschool children
- Clerical aptitudes, 257
- College success, prediction of, 248
- Correlation, of abilities, 225, 235, 244; statistics, 308; *see also* causation
- Delinquency, 254, 303
- Development, *see* genetic studies
- Emotions, and accidents, 266; and driving, 263; development of, 237; variability, 293
- Environment, and intelligence, 235, 241; and personality, 238; and school success 248
- Eugenics, 243
- Experiments, 310; on infants, 229
- Factor analysis, 231, 239, 257, 286, 297, 307, 312
- Family relationships, 293
- Genetic studies, *see* emotions, development of; growth; infants; language, development of; mental development; personality, development of; physical development; play; preschool children; social adjustment and behavior
- Graphology, 289
- Graphs, *see* nomographs, profiles
- Growth, curves, 235; *see also* genetic studies for cross references
- Handedness, 234, 265
- Handwriting, *see* graphology
- Home, *see* environment
- Homogeneous grouping, *see* ability grouping
- Infants, 229; *see also* preschool children
- Intelligence, and clerical ability, 257; and delinquency, 254; and driving, 264; and health, 244; and mechanical ability, 259; and moral behavior, 245; and music, 245; and occupations, 242, 251; and personality, 245; and physical defects, 253; and school success, 247; and sex differences, 244; surveys of, 246; testing programs, 246; *see also* accomplishment quotient, environment, racial differences
- Intelligence tests, applications of, 241; for infants and preschool children, 229; group, 223; incentives, 225; individual, 221; non-verbal, 226-230
- Interests, 275; surveys, 298
- Interviews, 279; as tests, 222, 265
- Item analysis, 307, 311
- Judgments, 281; *see also* rating
- Language, development of, 236, 254
- Marital relationships, 292
- Measurement, incentives, 225; needed research, 316; unit of, 308; *see also* factor analysis, rating, reliability, scaling, tests and scales, validity, particular subject field
- Mechanical aptitudes, 258
- Memory, 226, 236
- Mental development, *see* intelligence, genetic studies for cross references

- Mental tests, *see* psychological tests
 Moral behavior, 245, 302; *see also* cheating
 Motion pictures, *see* photographic recording
 Motor abilities, 226, 233, 244, 259; *see also* physical development
 Music, and intelligence, 245; aptitude, 262; measurement of, 231; psychology of, 237
 Nationality and intelligence, *see* racial differences
 Nature and nurture, *see* environment
 Needed research, intelligence testing, 256; measurement, 316; personality study, 217; psychological tests, 217; reporting intelligence scores, 250
 Negroes, *see* racial differences
 Nomographs, 307
 Observation, 231, 237, 239; of behavior, 289, *see also* photographic recording
 Occupations, and fecundity, 243; and intelligence, 242, 251; *see also* environment, vocational aptitudes
 Parent-child relationships, 277
 Personality, and delinquency, 255; and intelligence, 245; development of, 237; measurement of, 269; needed research, 217; rating, 281; studies of, 229; surveys, 292; *see also* adjustment, psychological tests and cross references, rating
 Photographic recording, 233, 237, 240
 Physical defects, 244
 Physical development, 244, 315; *see also* motor abilities, genetic studies for cross references
 Pictures, 237, *see* photographic recording
 Play, 231, 239
 Prediction of school success, 247, 275, *see* particular subject field
 Preschool children, 229, *see also* infants
 Professional aptitudes, 261
 Profiles, occupational, 266
 Psychological tests and scales, 308; *see also* aptitude, attitudes, character, intelligence, interests, moral behavior, needed research, personality, social behavior, surveys, vocational aptitude.
 Racial differences, 230, 234, 237, 243, 295
 Racial prejudices, 279, 300
 Rating, of personality, 281, 307; scales, 231
 Reading, errors in, 236; interests, 276; readiness, 247
 Reasoning, 236
 Records, 291; pupil, 246; test, 249; *see also* photographic recording
 Reliability, 309
 Religious attitudes, 279
 Safety, 263, *see also* accidents, automobile driving
 Sampling, 239, 310; *see also* statistical methods, tests of significance
 Scales, *see* scaling, tests and scales, particular subject field
 Scaling, 307; *see also* measurement, scoring, unit of
 Scholastic aptitude, *see* predicting school success
 Scoring, 307, 311
 Sex differences, in intelligence, 244; in music, 262
 Social adjustment and behavior, 238; measurement of, 231
 Speech defects, 255
 Statistical methods, 307; tests of significance, 310; *see also* correlation, factor analysis, nomographs, sampling, tabulating machines, tests, weighting
 Surveys, intelligence, 246
 Tabulating machines, 307, 309
 Teachers, traits, 304
 Tests and scales, construction of, 311; *see also* item analysis, measurement, psychological tests, scoring, particular subject field
 Unit, *see* measurement
 Validity, 311
 Variability, between abilities, 241; between individuals, 241, 258; in occupational groups, 267; in performance, 264; in personality measurements, 271; *see also* ability grouping, reliability, sex differences
 Vital statistics, *see* birth rates, eugenics
 Vocabulary, and intelligence, 248, 253; of preschool children, 231; test, 231
 Vocational aptitude, 257, 304; *see also* predicting school success, professional aptitudes
 Vocational guidance, 304
 Weighting, 309; 312